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KÖNITZ(10) **Pub. No.: US 2018/0187656 A1**(43) **Pub. Date: Jul. 5, 2018**(54) **WIND TURBINE AND COOLING DEVICE
FOR A WIND TURBINE****Publication Classification**(51) **Int. Cl.****F03D 80/60** (2006.01)**F03D 13/20** (2006.01)(52) **U.S. Cl.**CPC **F03D 80/60** (2016.05); **F05B 2260/64**
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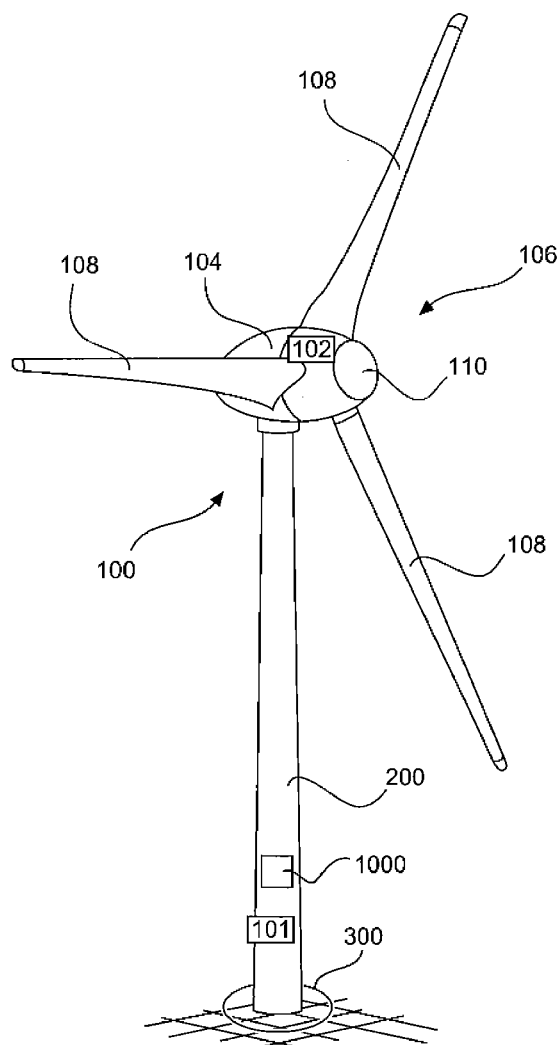
(2) Date: **Dec. 26, 2017**(30) **Foreign Application Priority Data**

Jul. 1, 2015 (DE) 10 2015 212 321.9

(57)

ABSTRACT

There is provided a wind turbine comprising a tower which has a wall, a cooling device having an air inlet unit and an air outlet unit which are provided in the lower region of the tower. The air inlet unit and the air outlet unit each have an outer portion, a central portion and a shutter unit. The outer portions are provided outside the wall of the tower, the central portions are provided in the region of the wall of the tower and the shutter units are provided within the tower. The air inlet unit and the air outlet unit have fixing units, by means of which the central portions can be fixed to the wall of the tower from the interior of the tower.



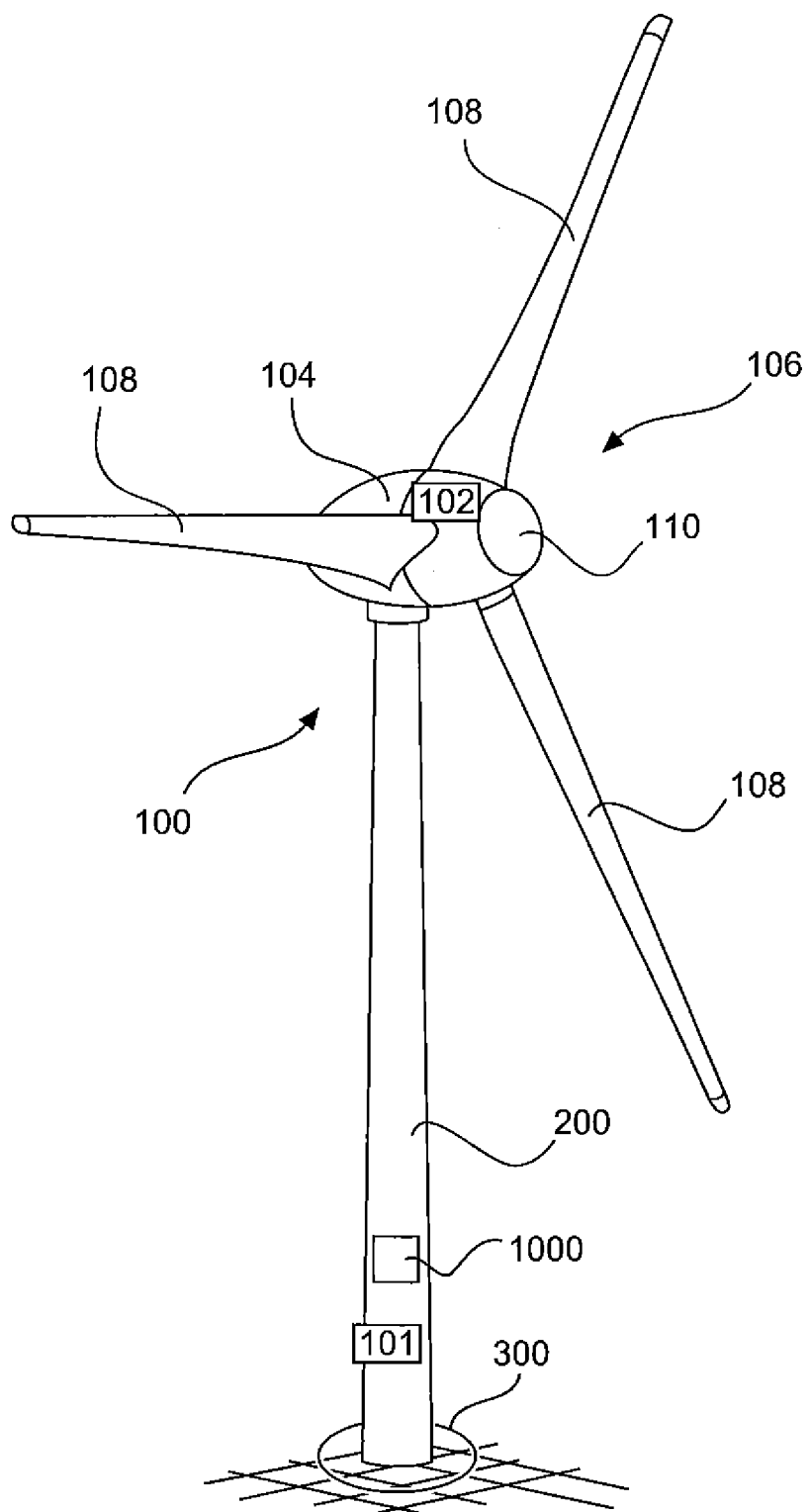


Fig. 1

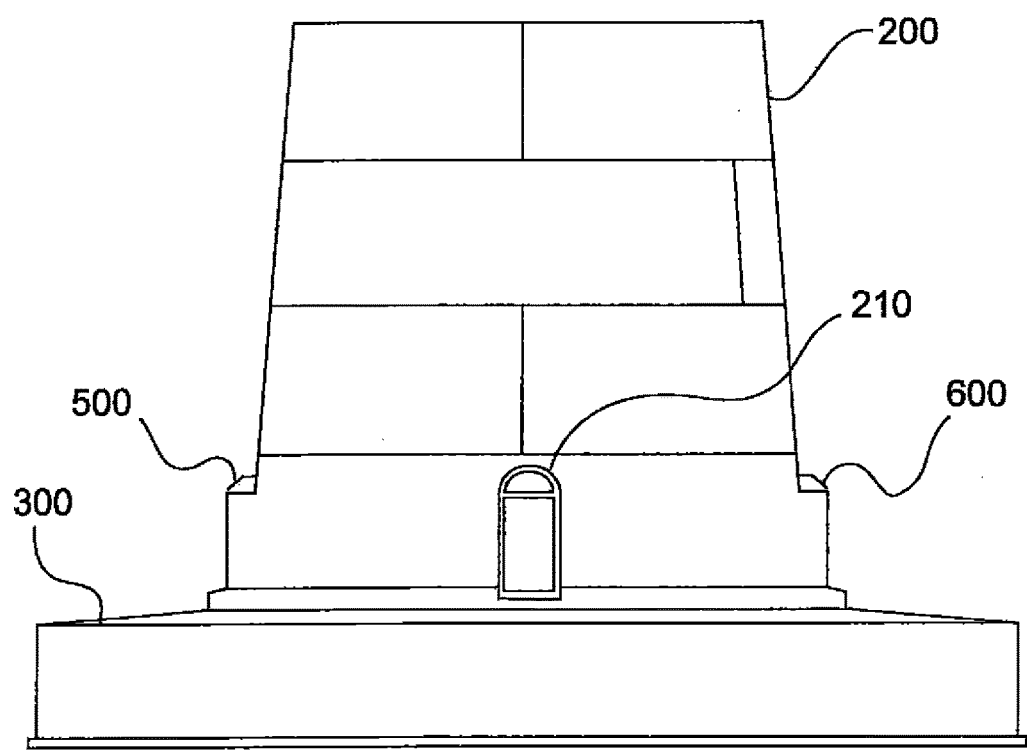


Fig. 2

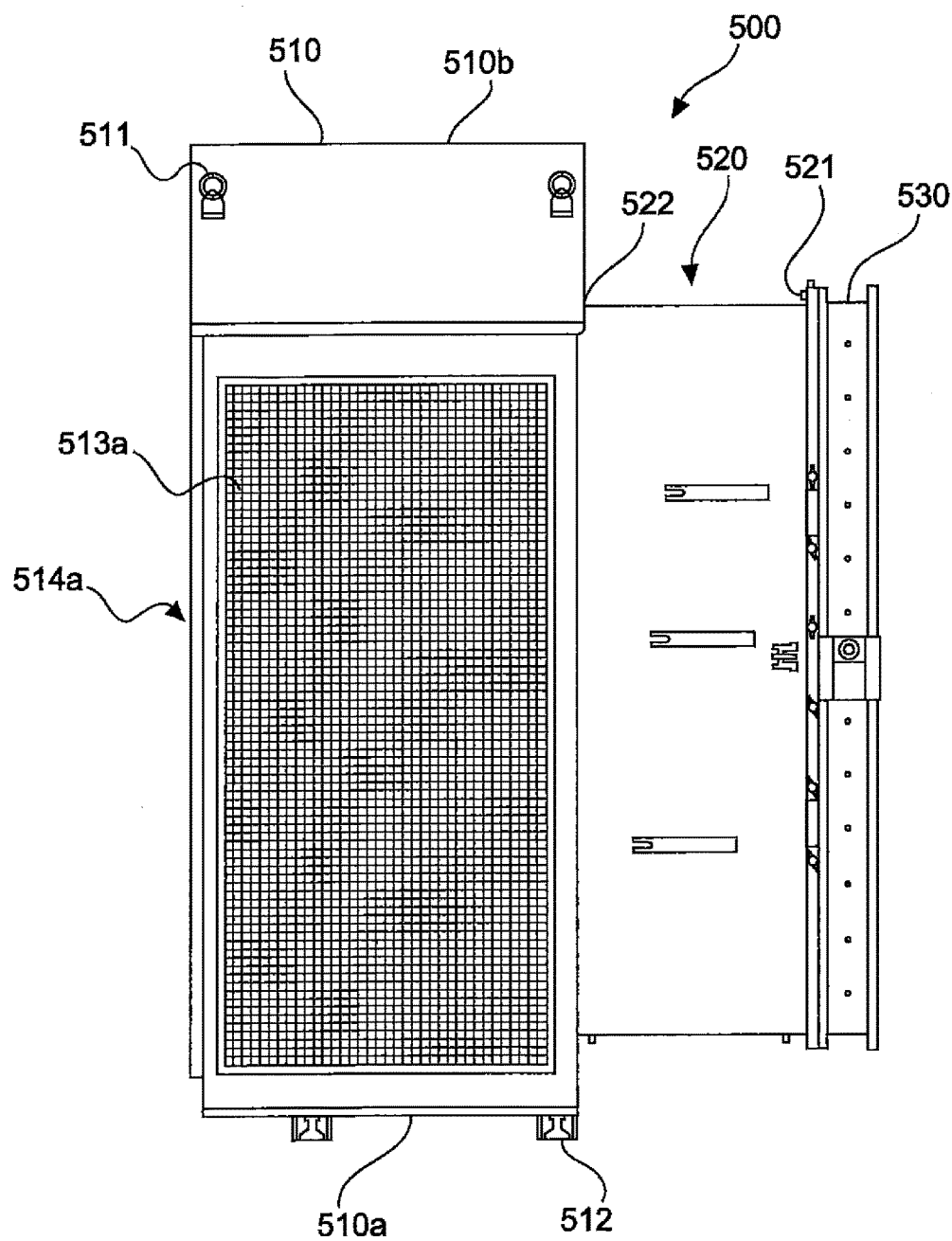


Fig. 3A

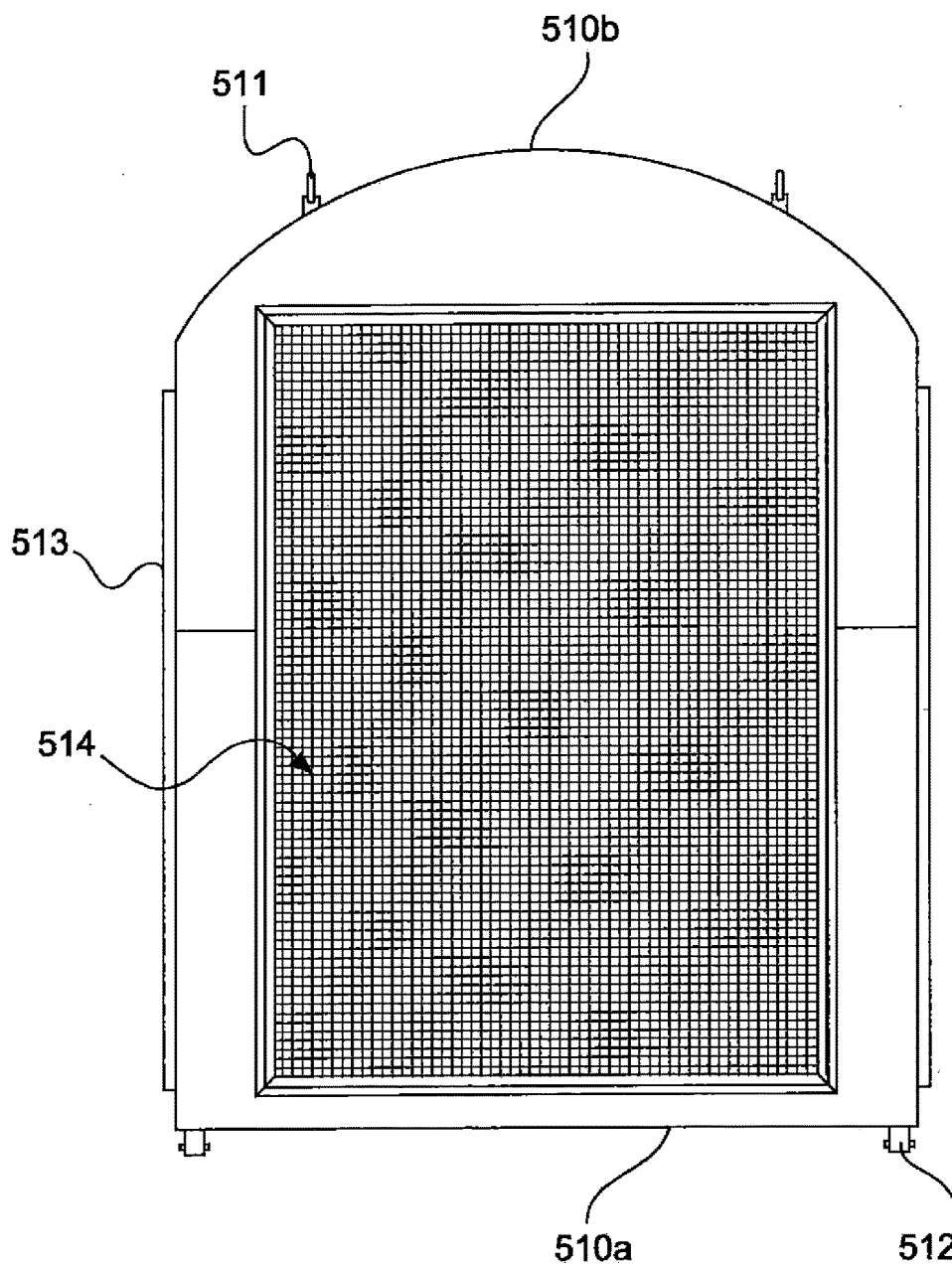


Fig. 3B

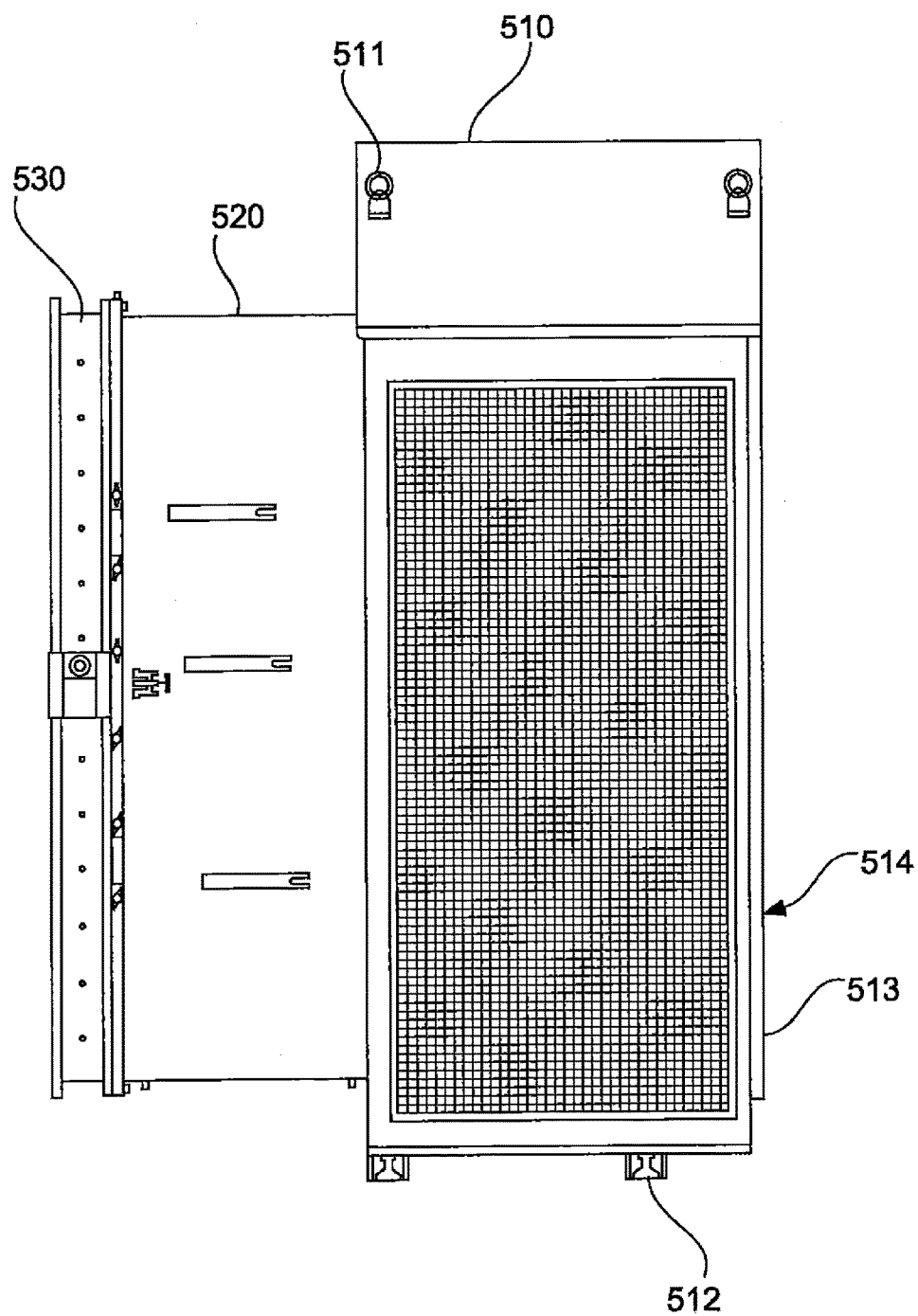


Fig. 3C

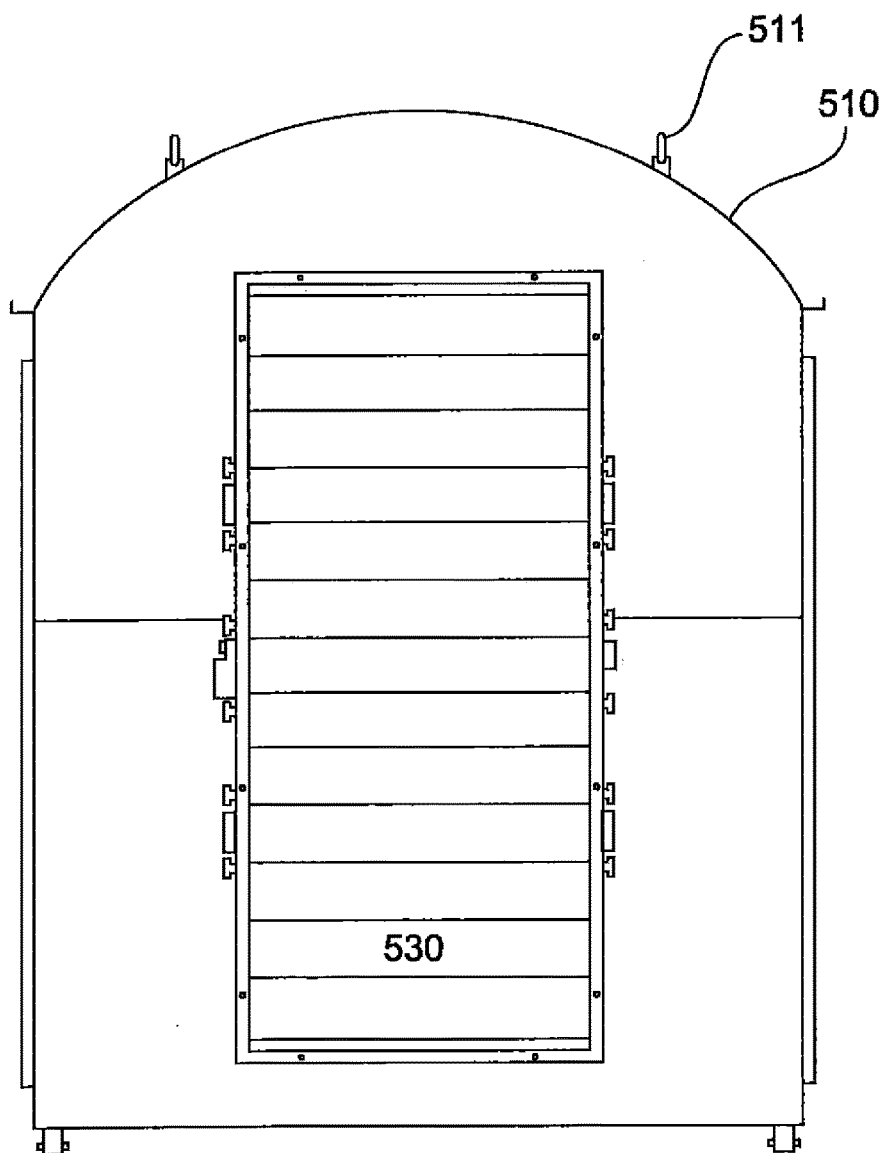


Fig. 3D

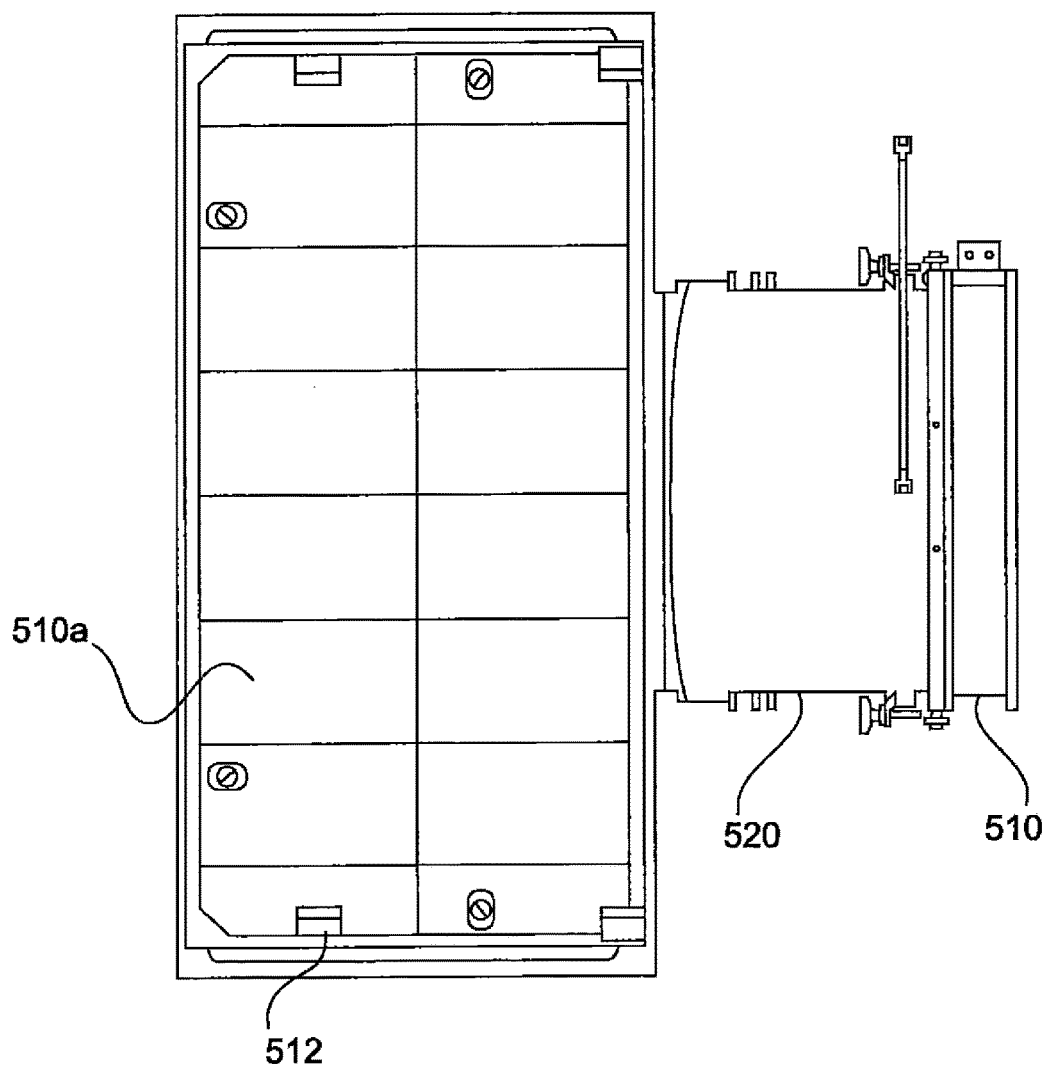


Fig. 3E

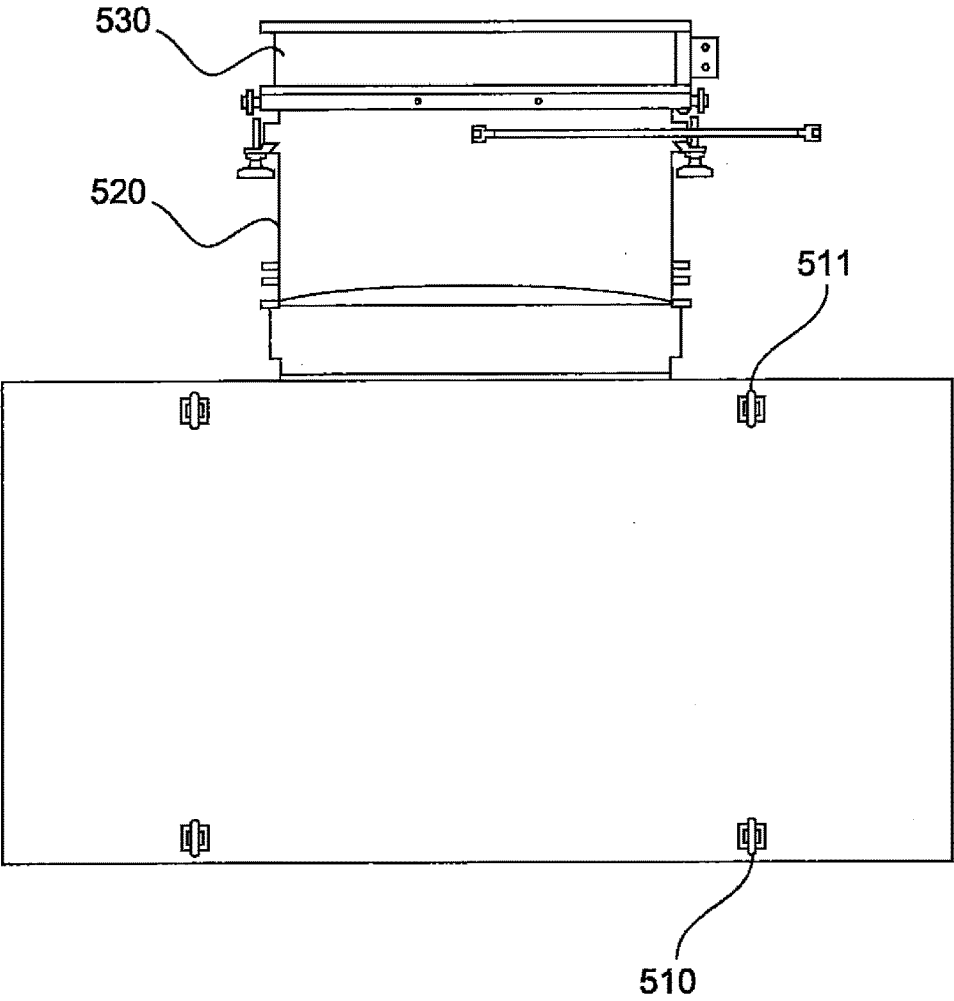


Fig. 3F

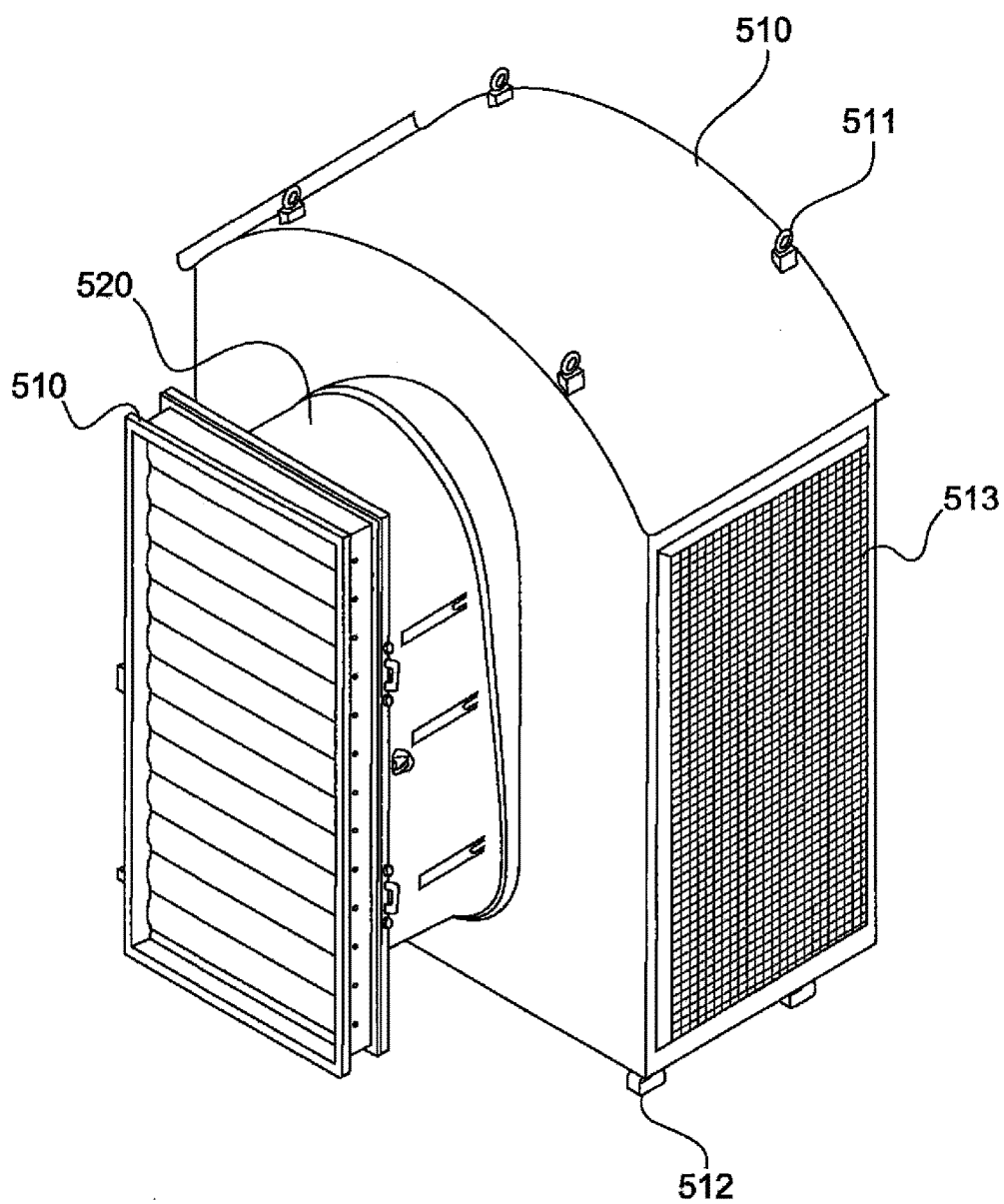


Fig. 3G

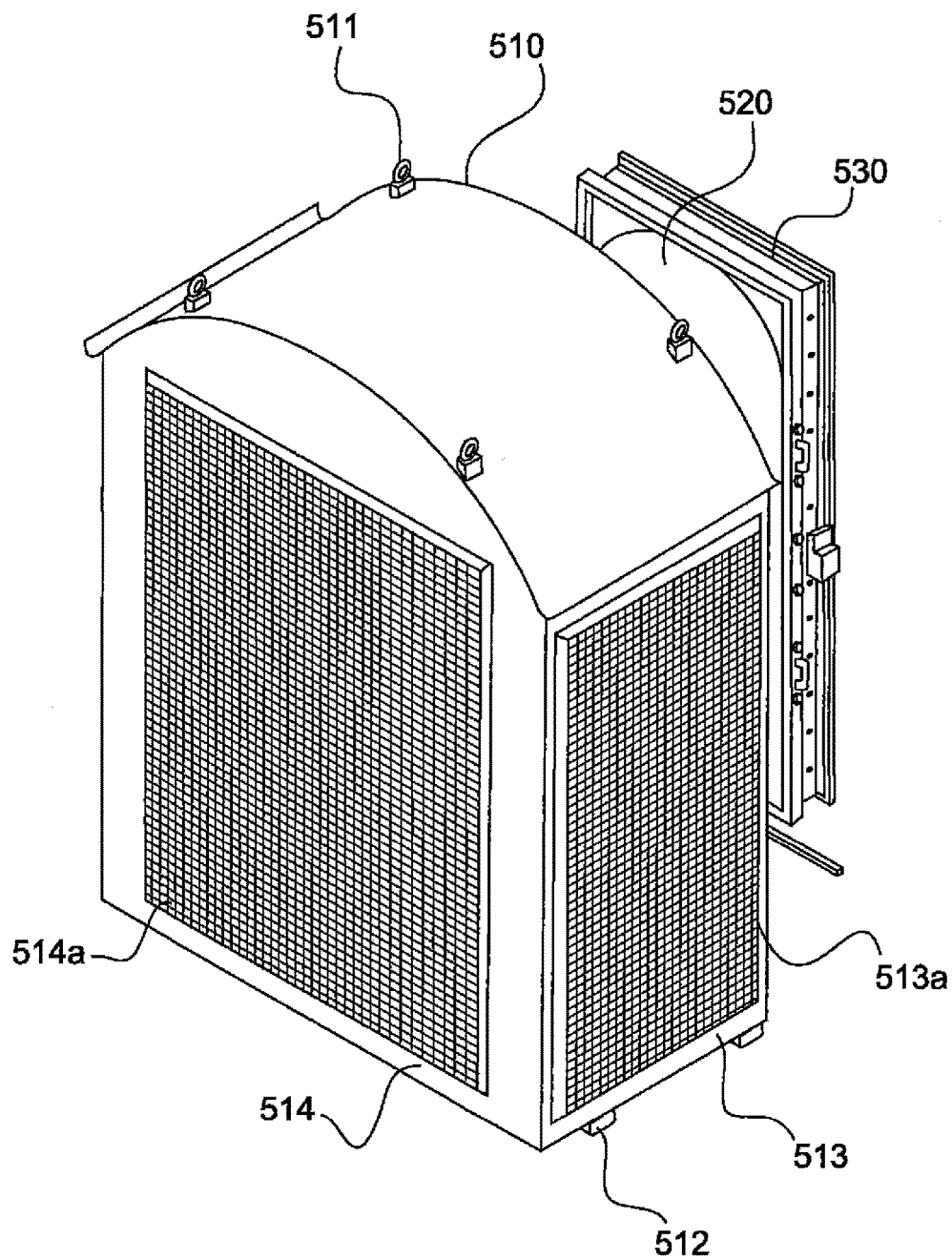


Fig. 3H

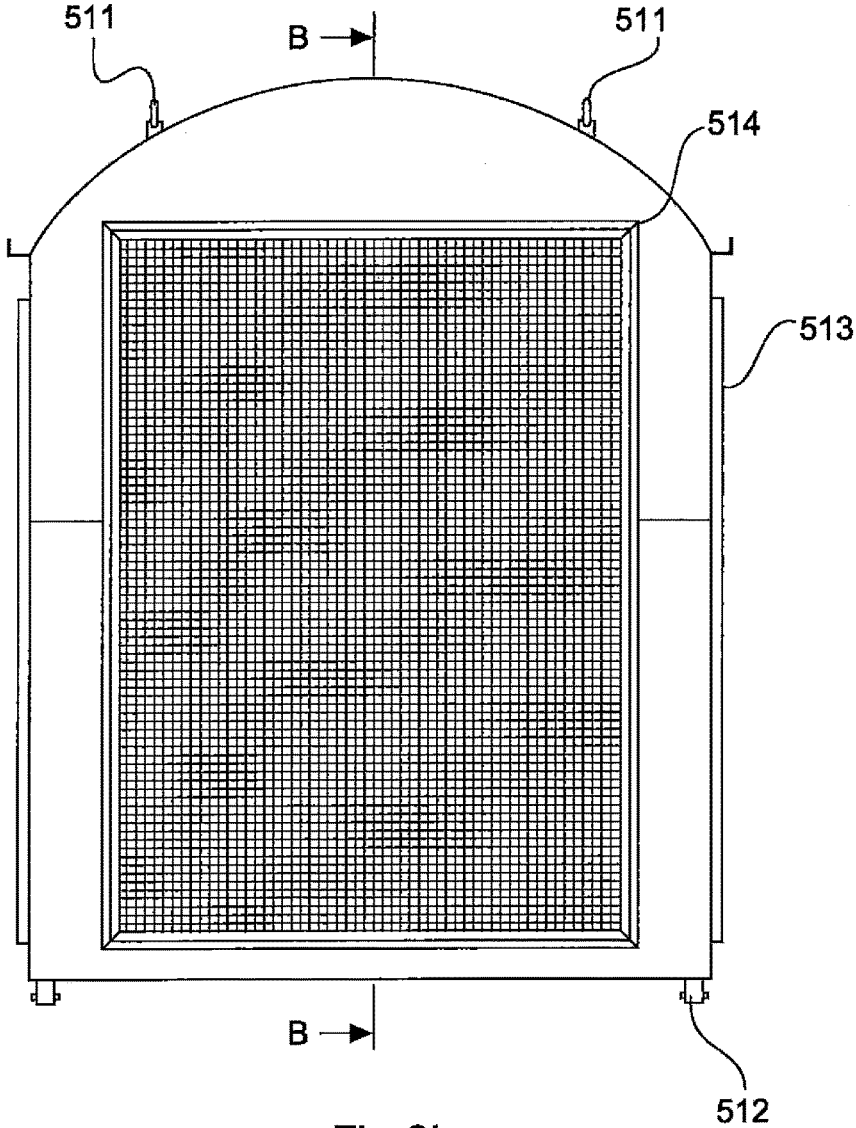


Fig. 31

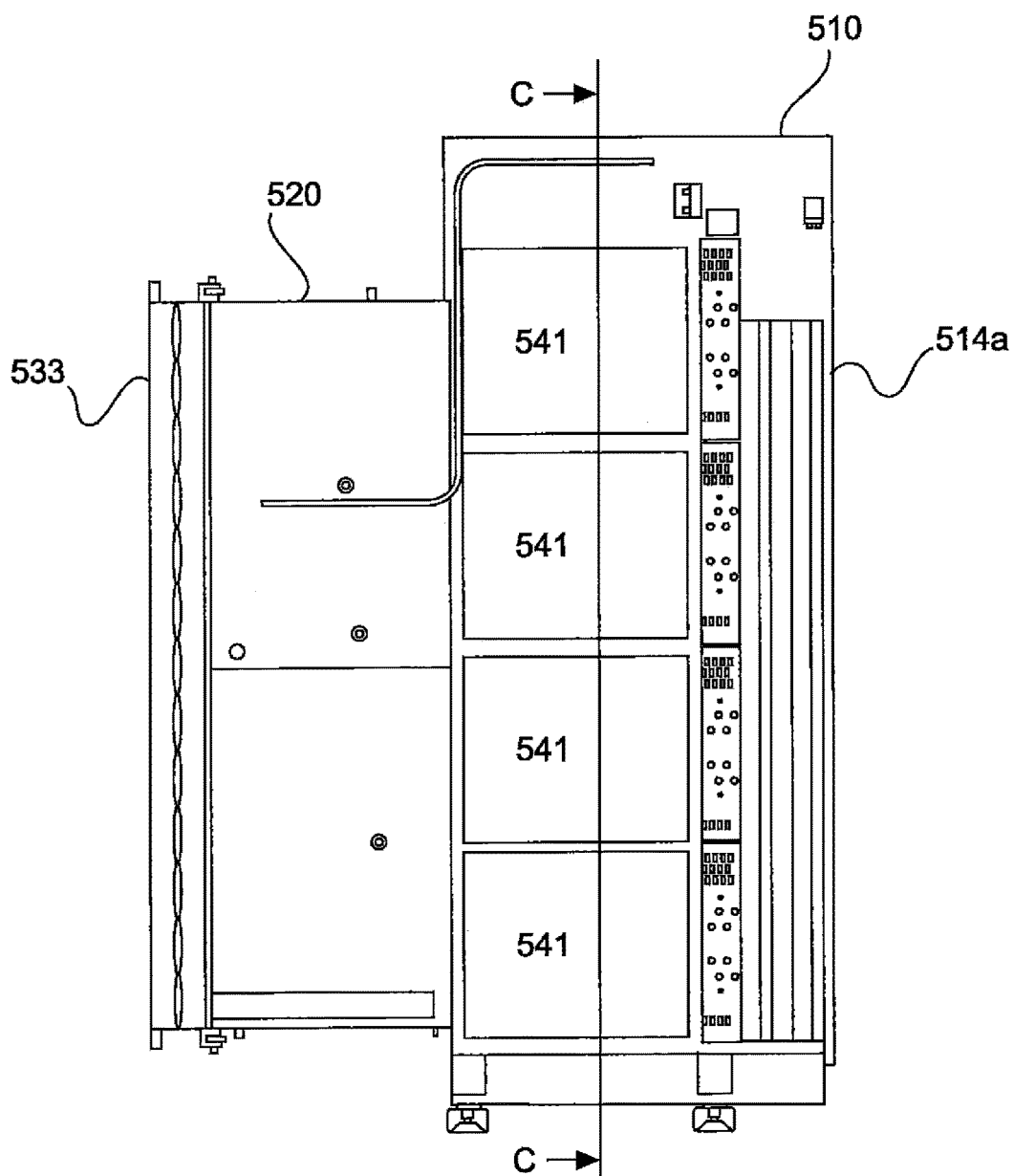


Fig. 3J

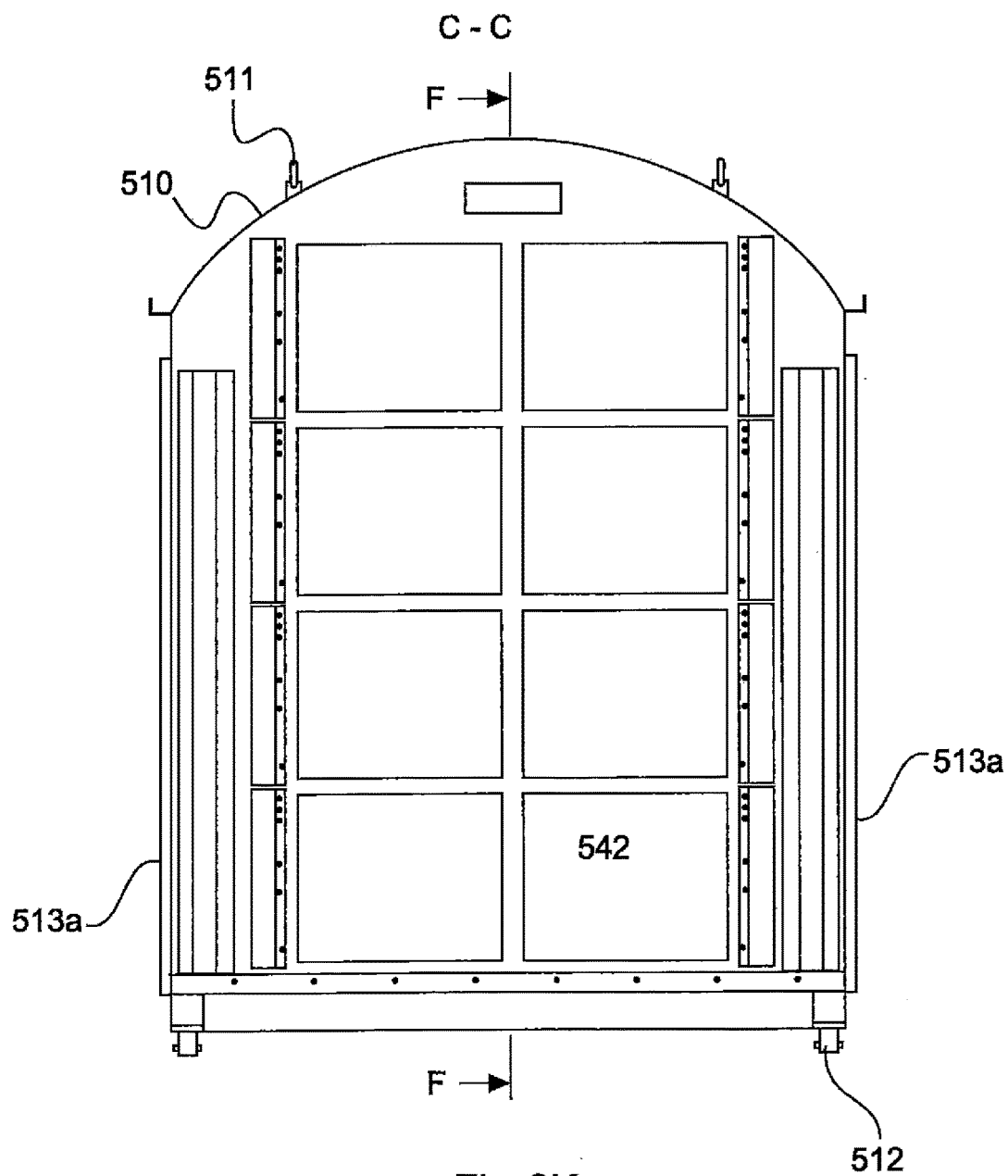


Fig. 3K

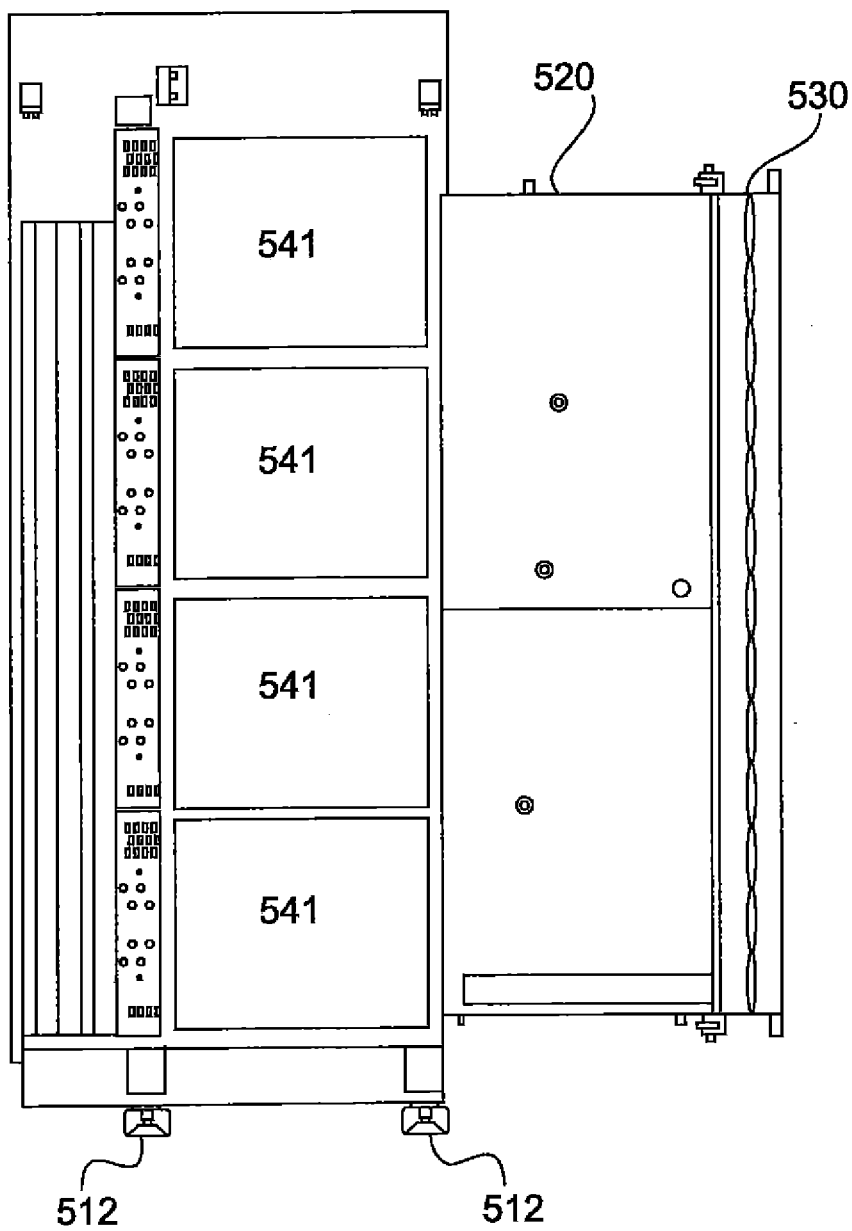


Fig. 3L

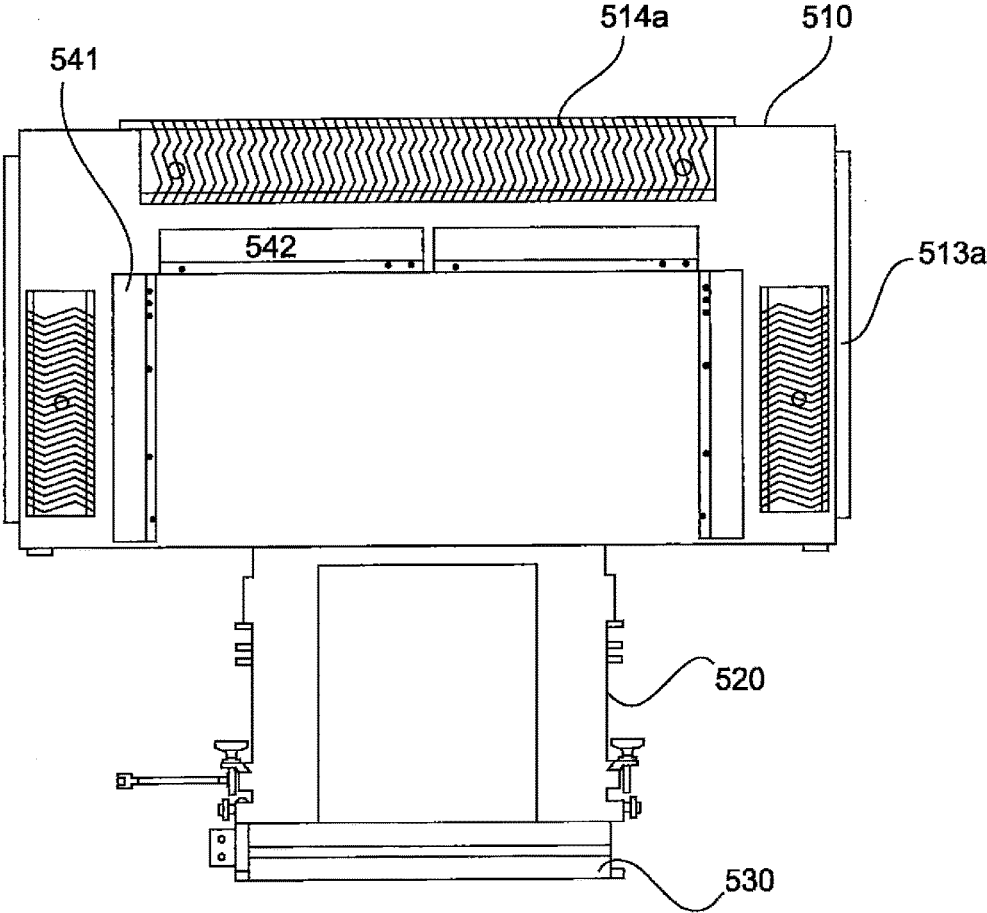


Fig. 3M

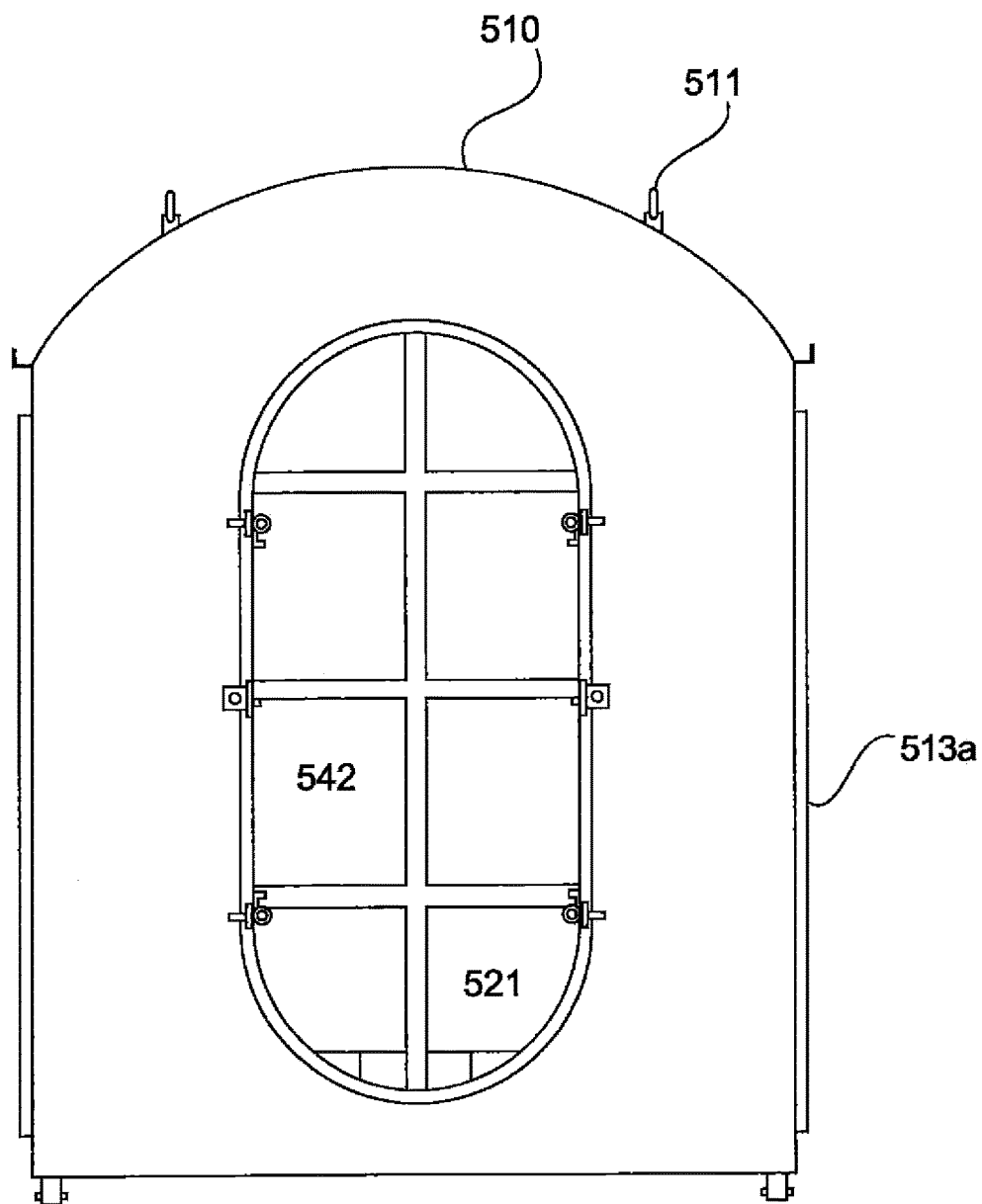
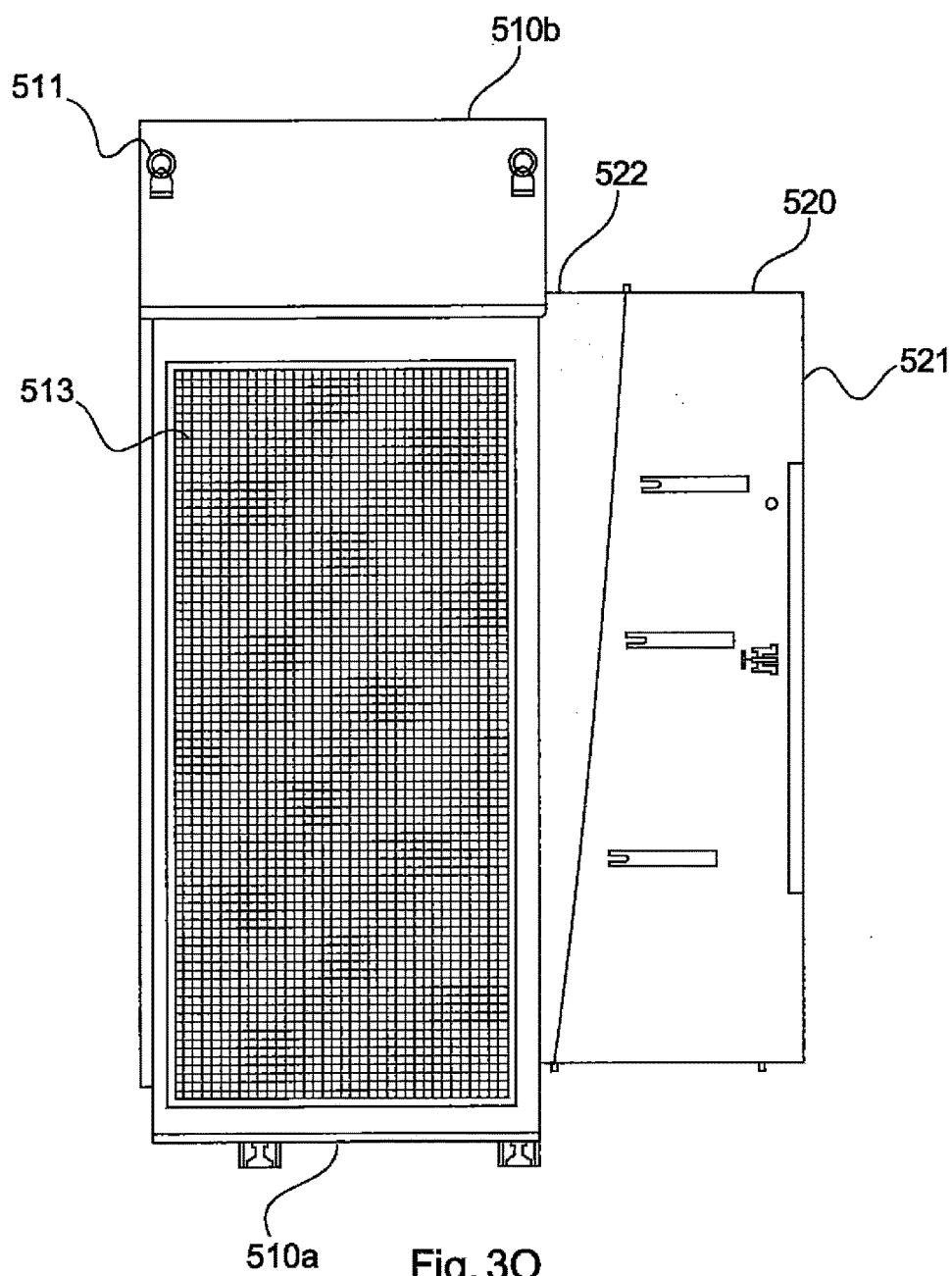


Fig. 3N



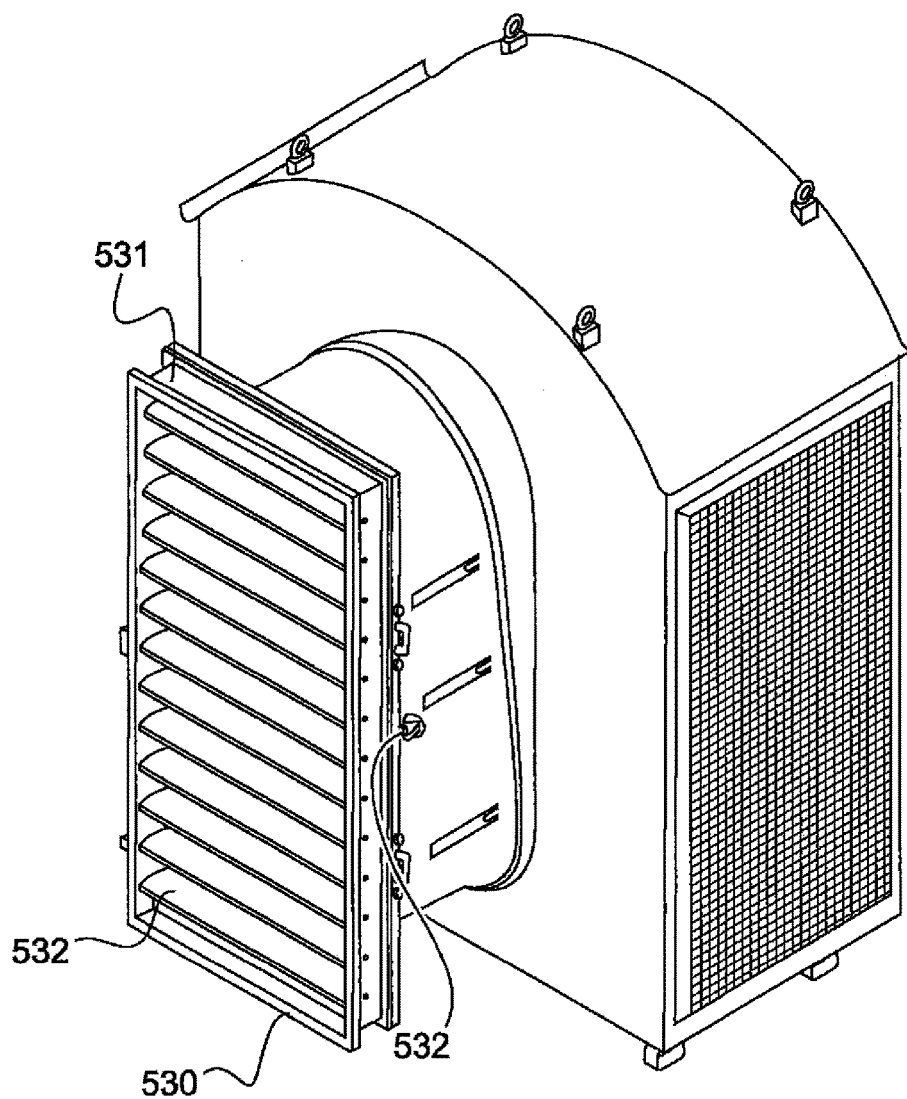


Fig. 3P

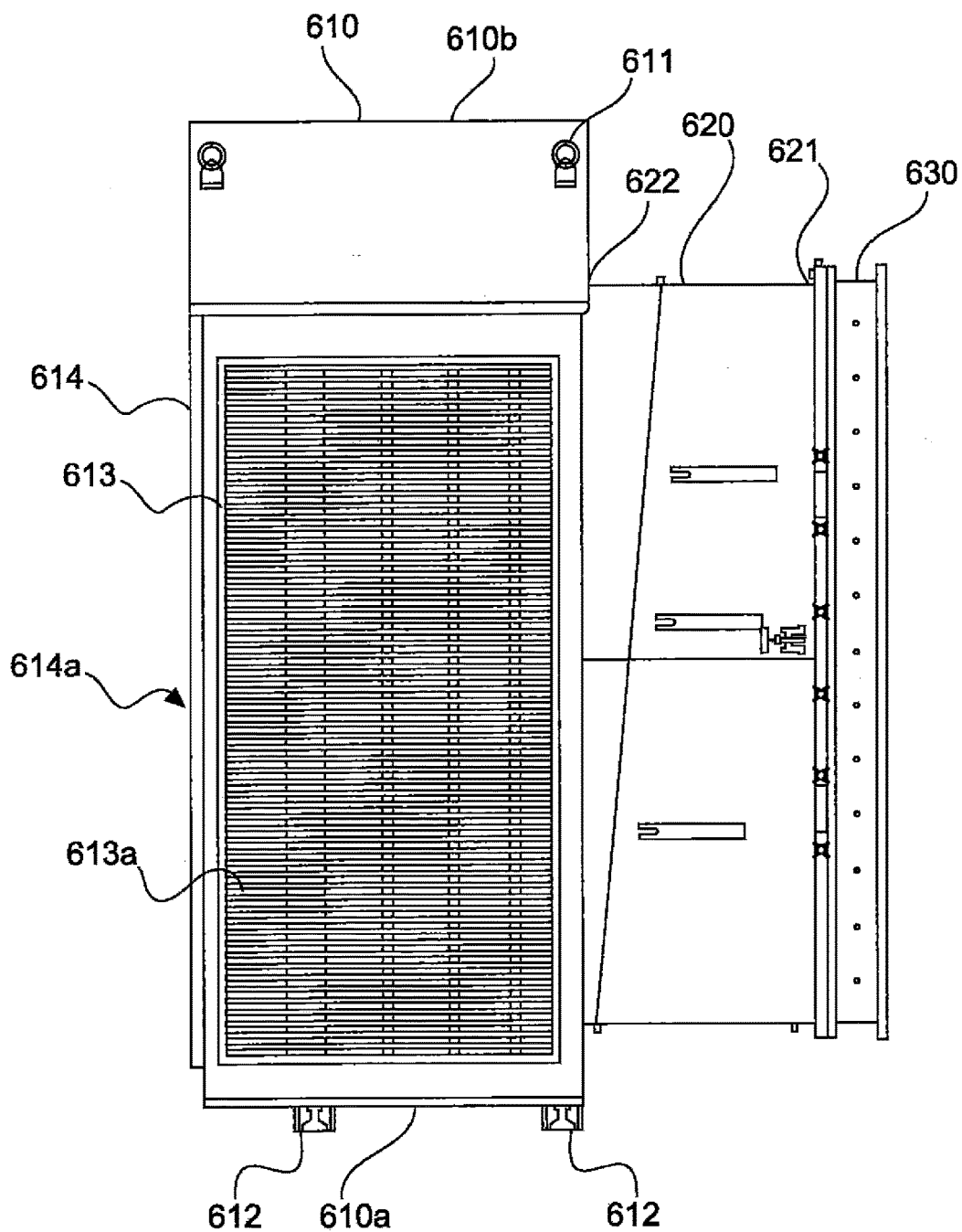


Fig.4A

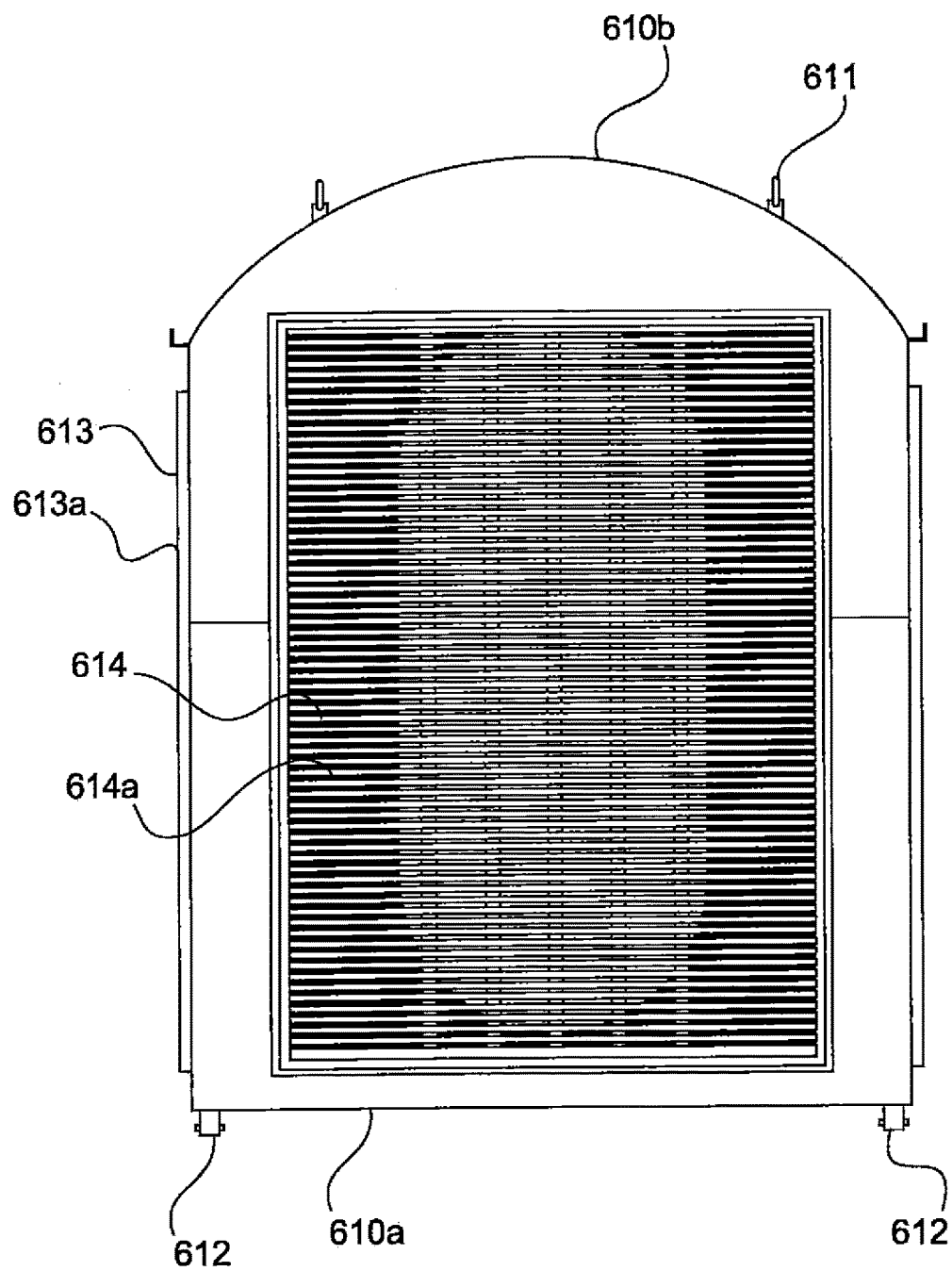


Fig.4B

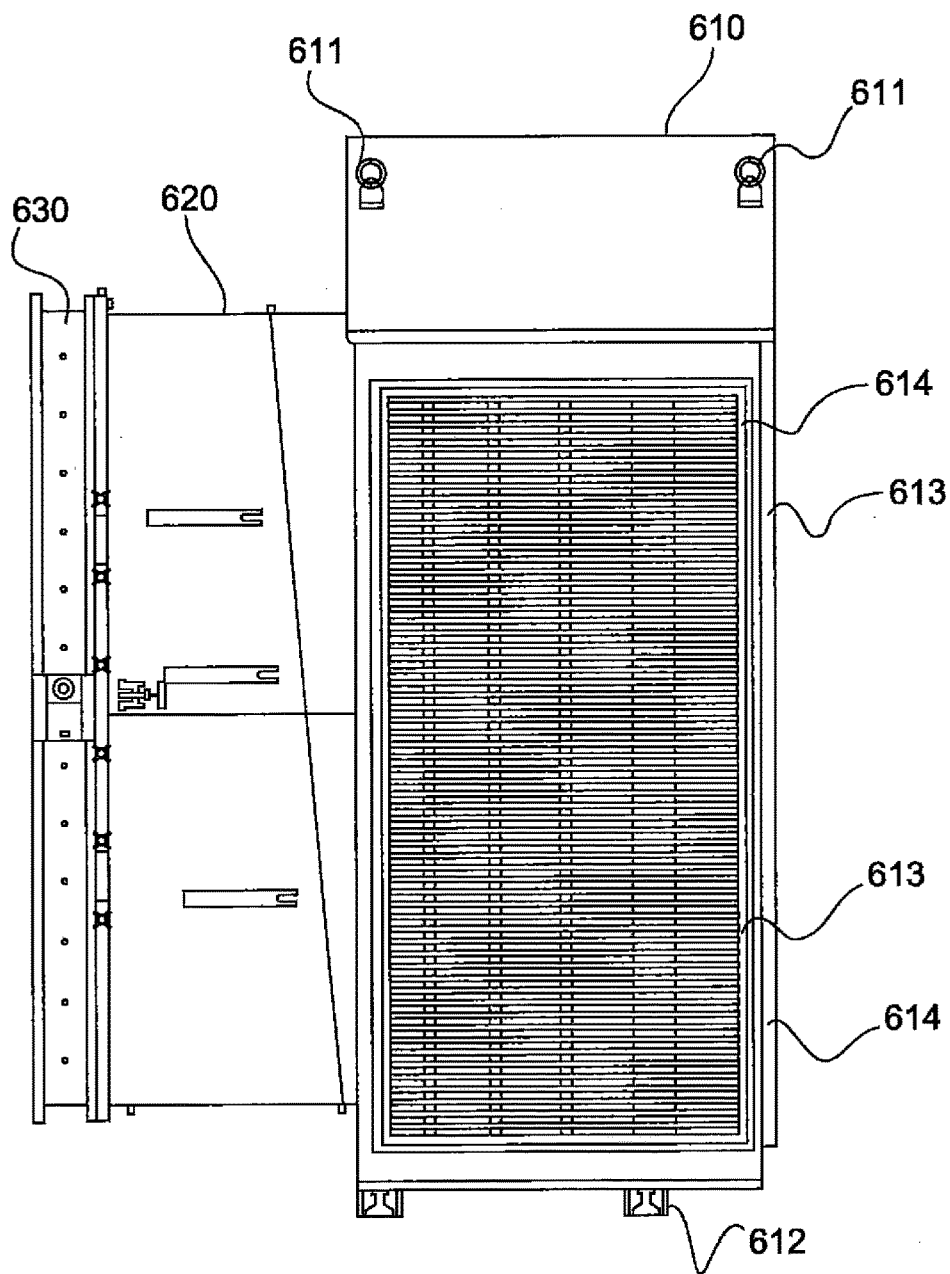


Fig.4C

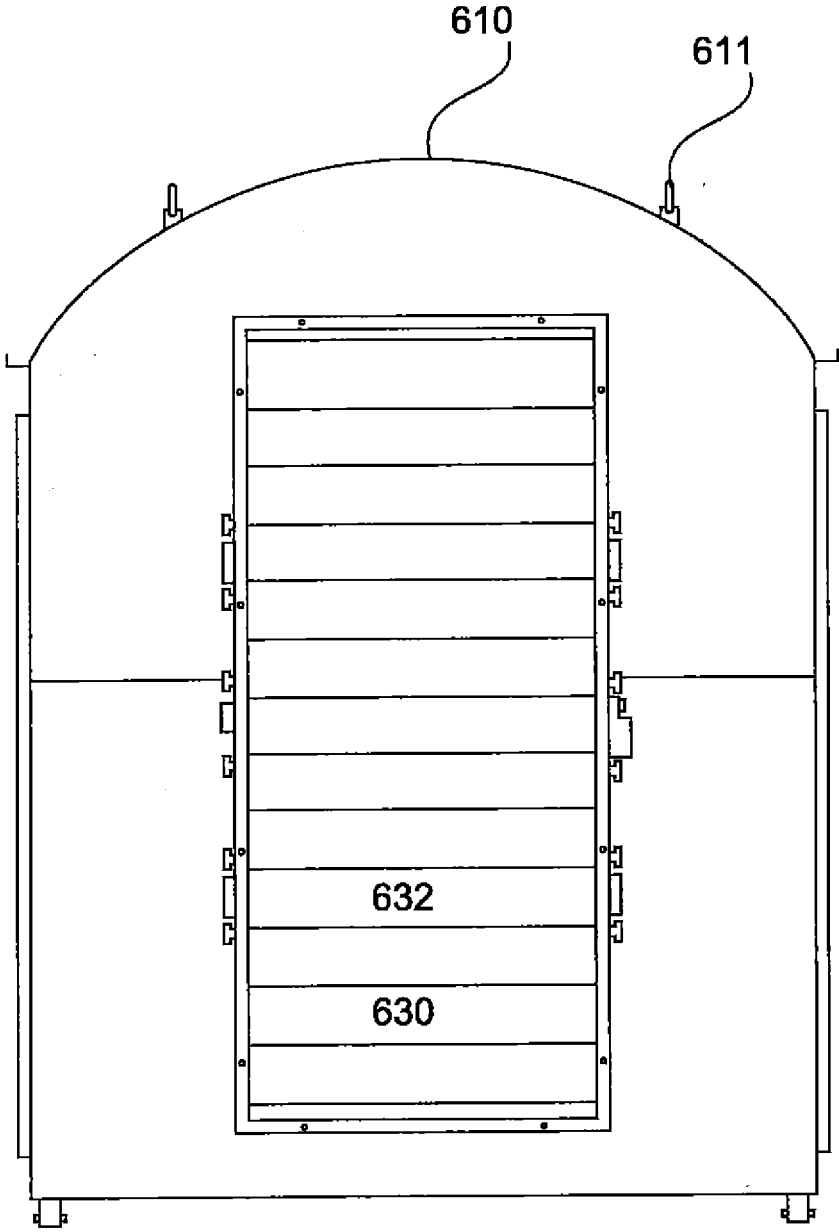


Fig.4D

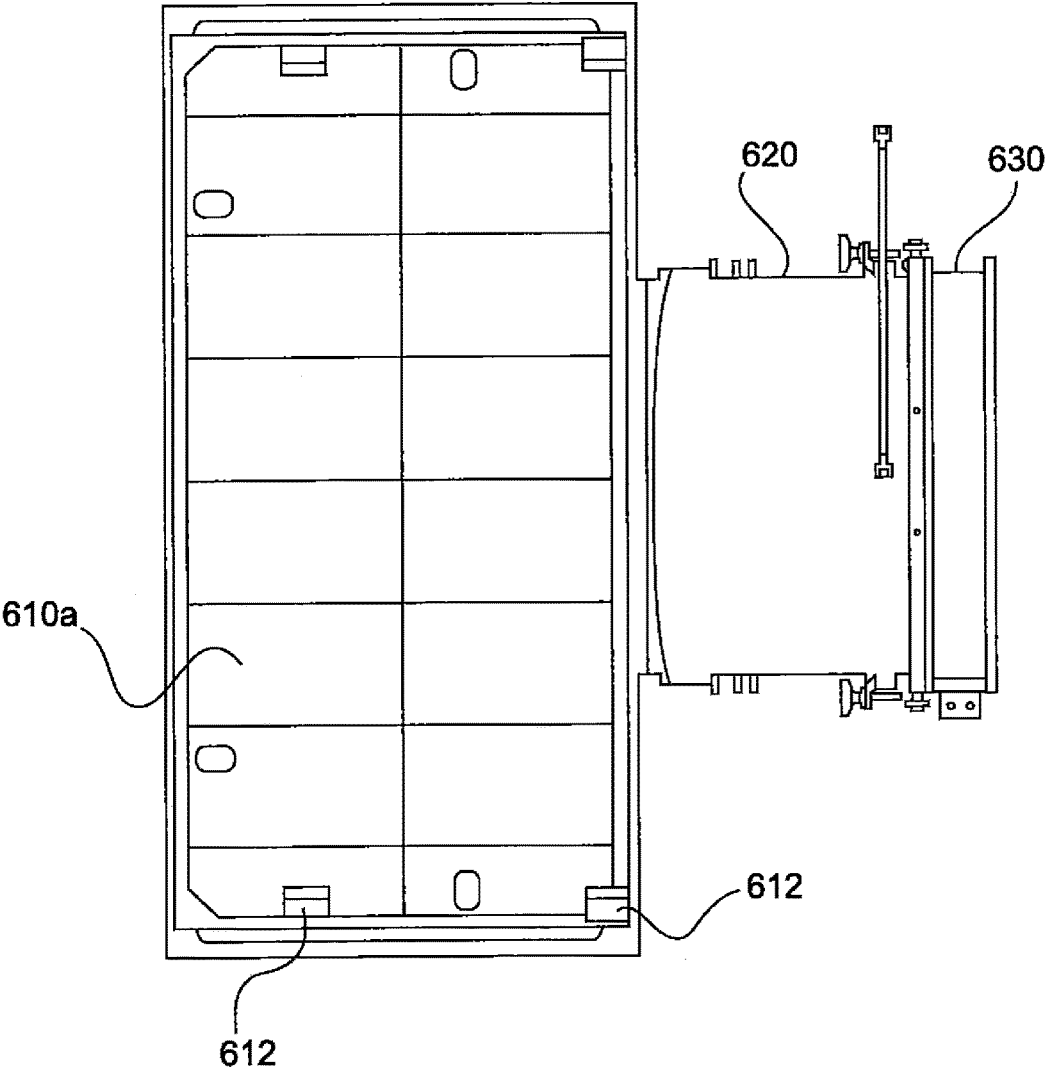


Fig.4E

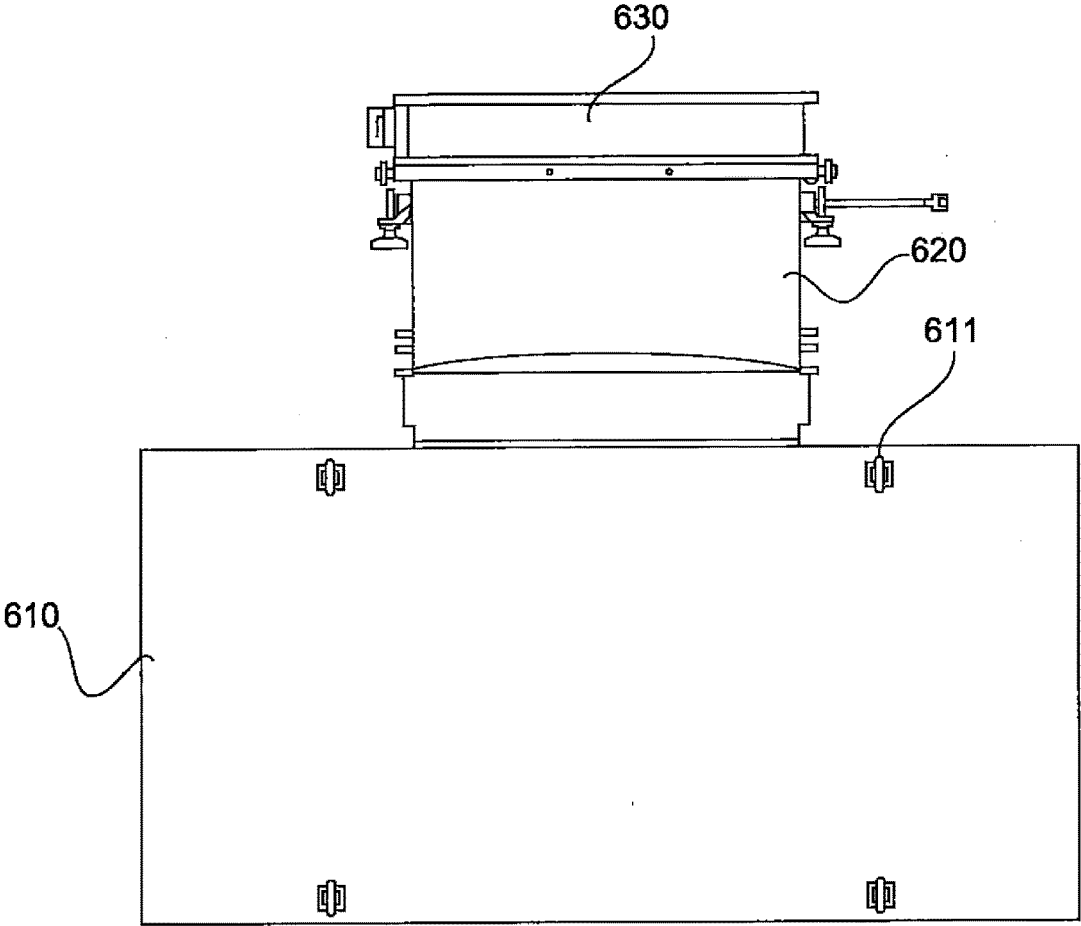


Fig.4F

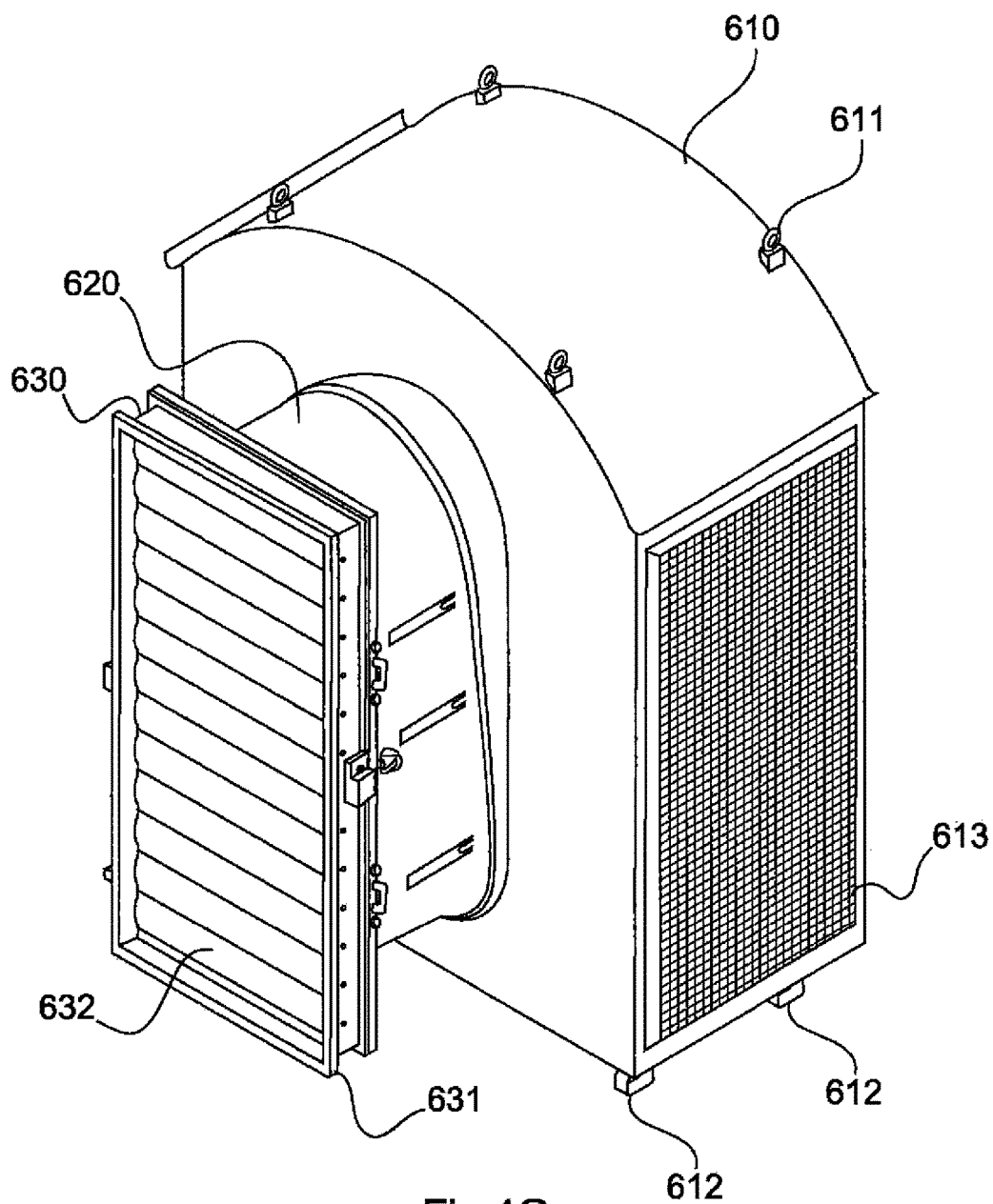


Fig.4G

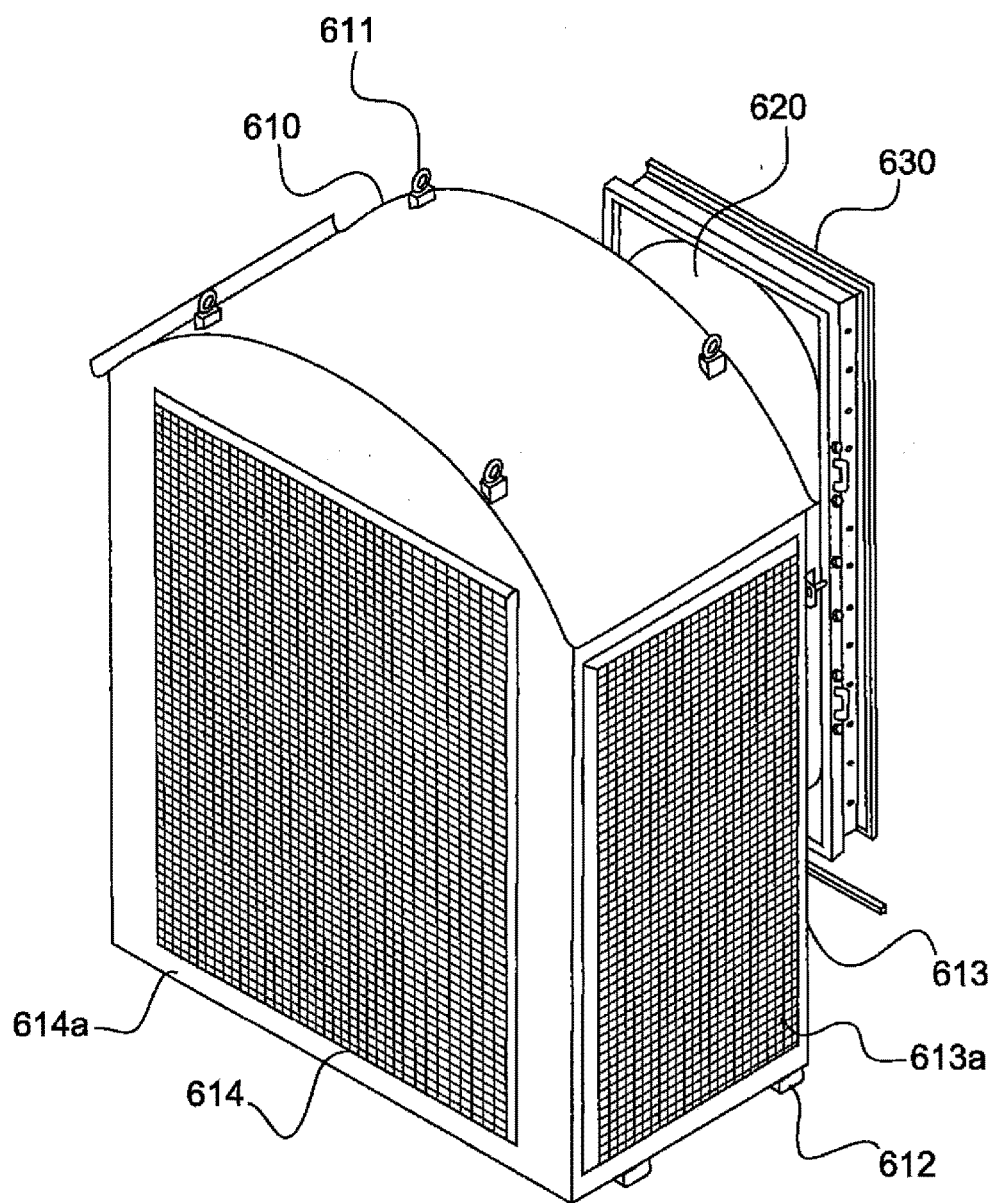


Fig.4H

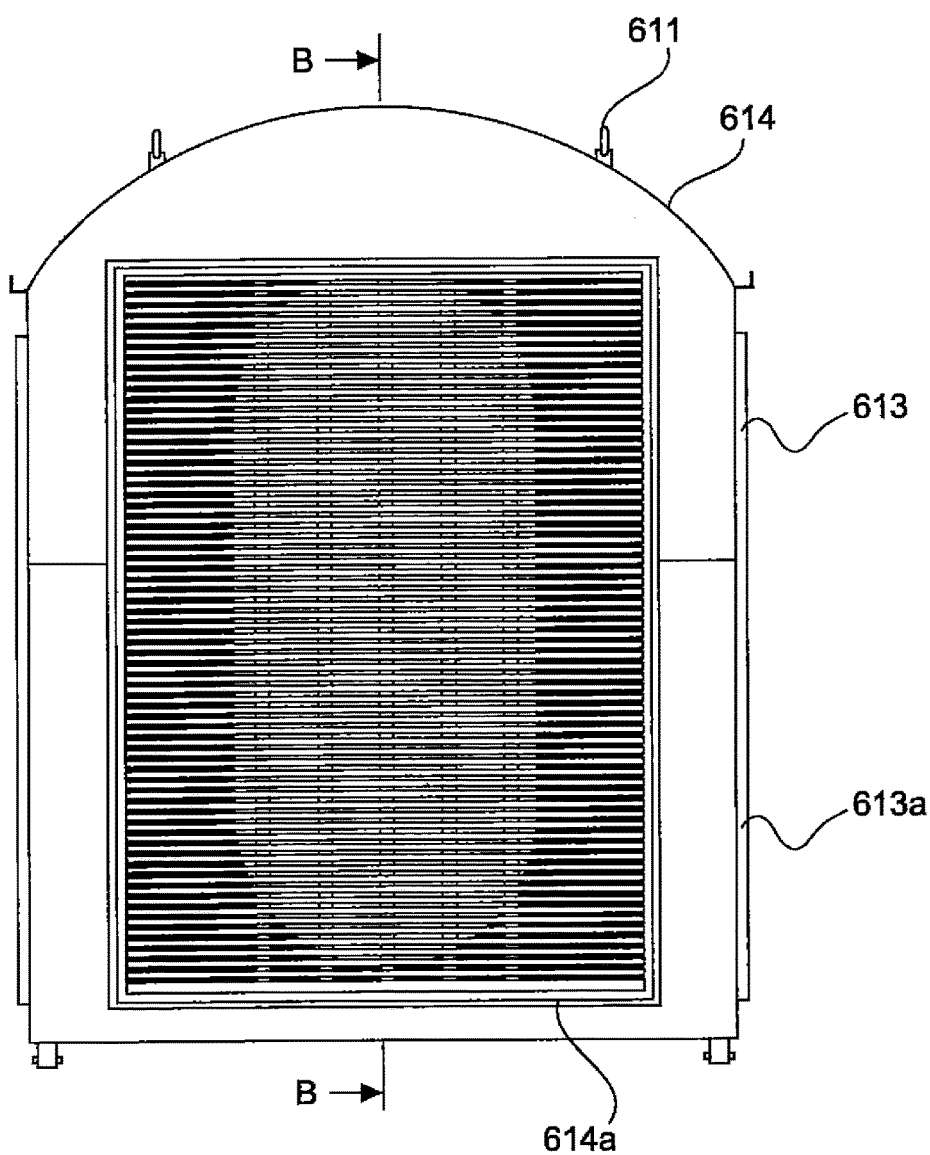
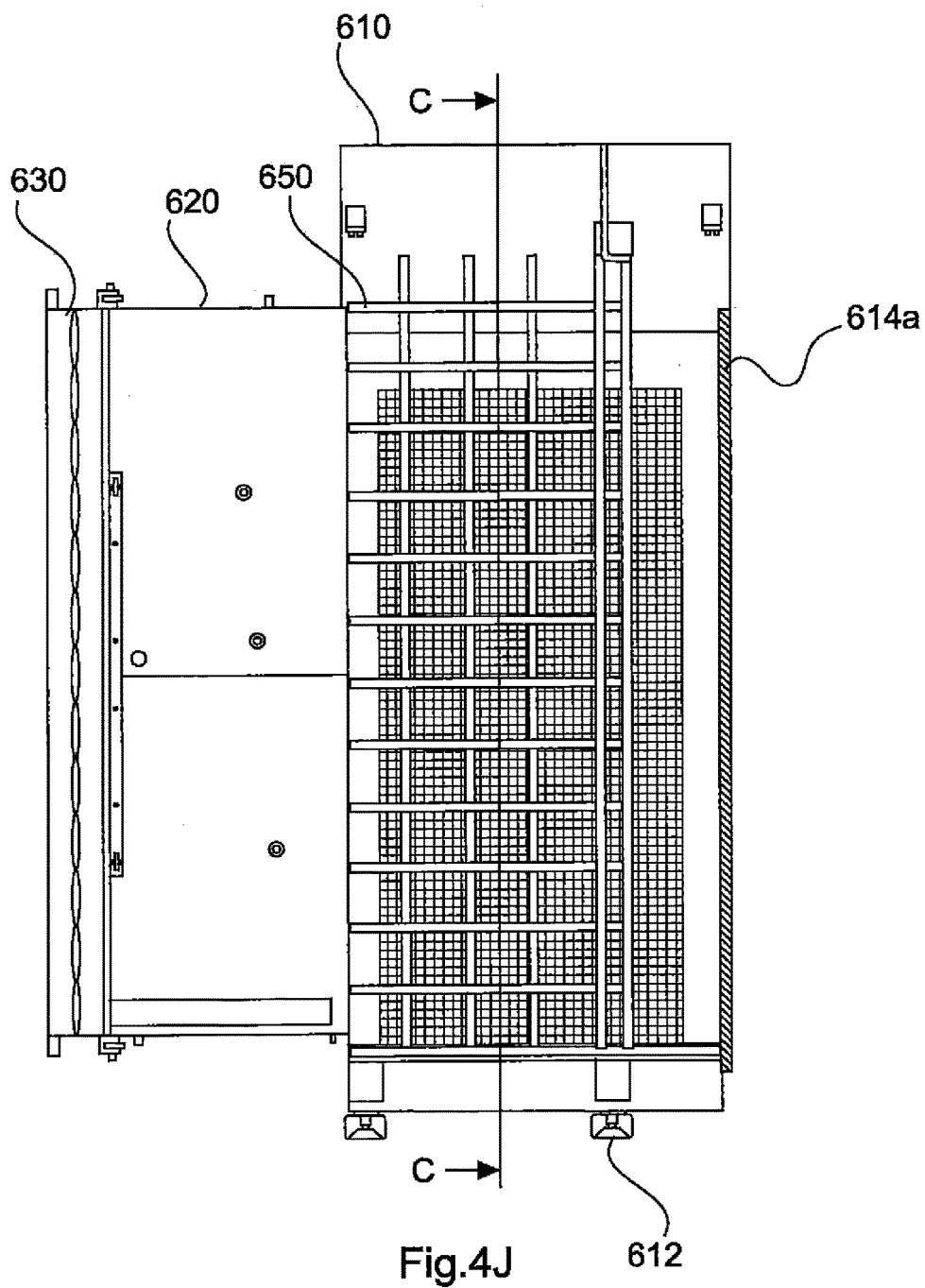


Fig.4I



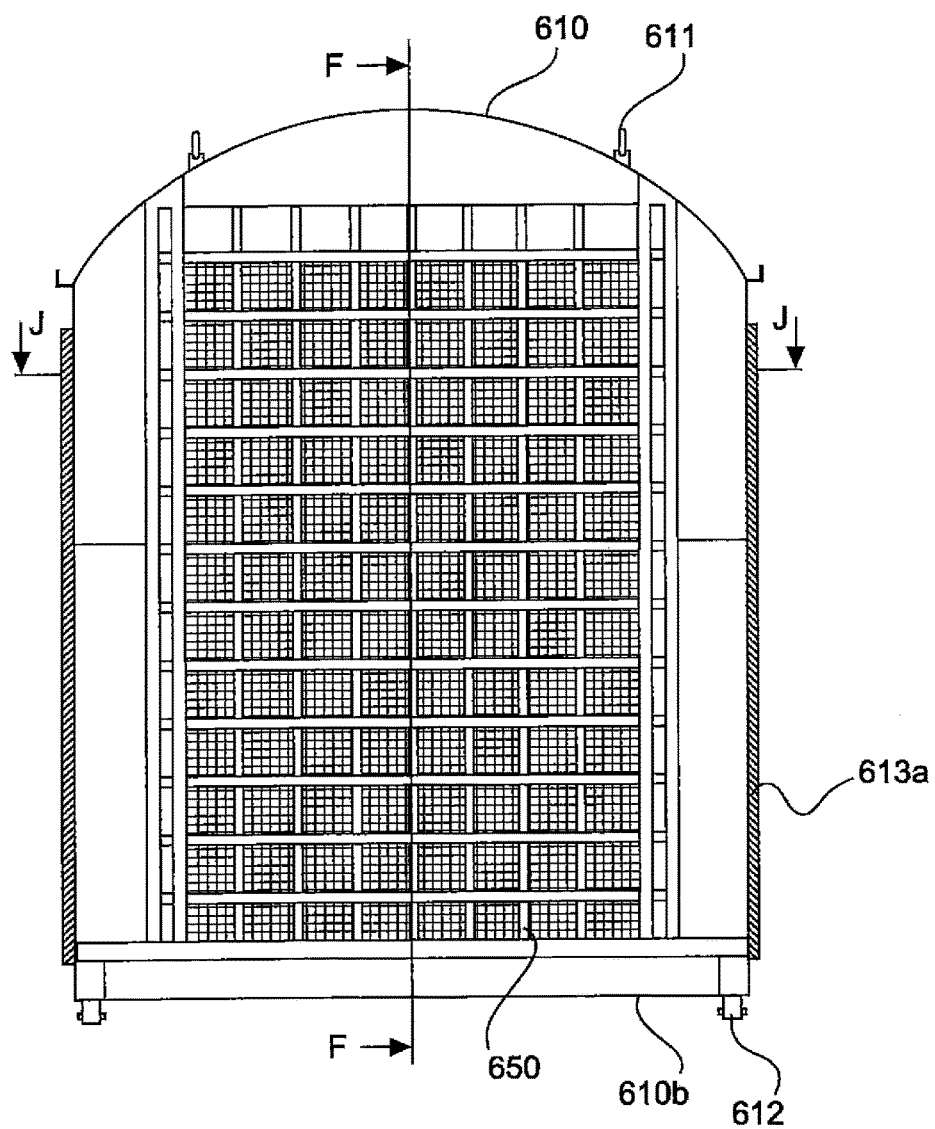


Fig.4K

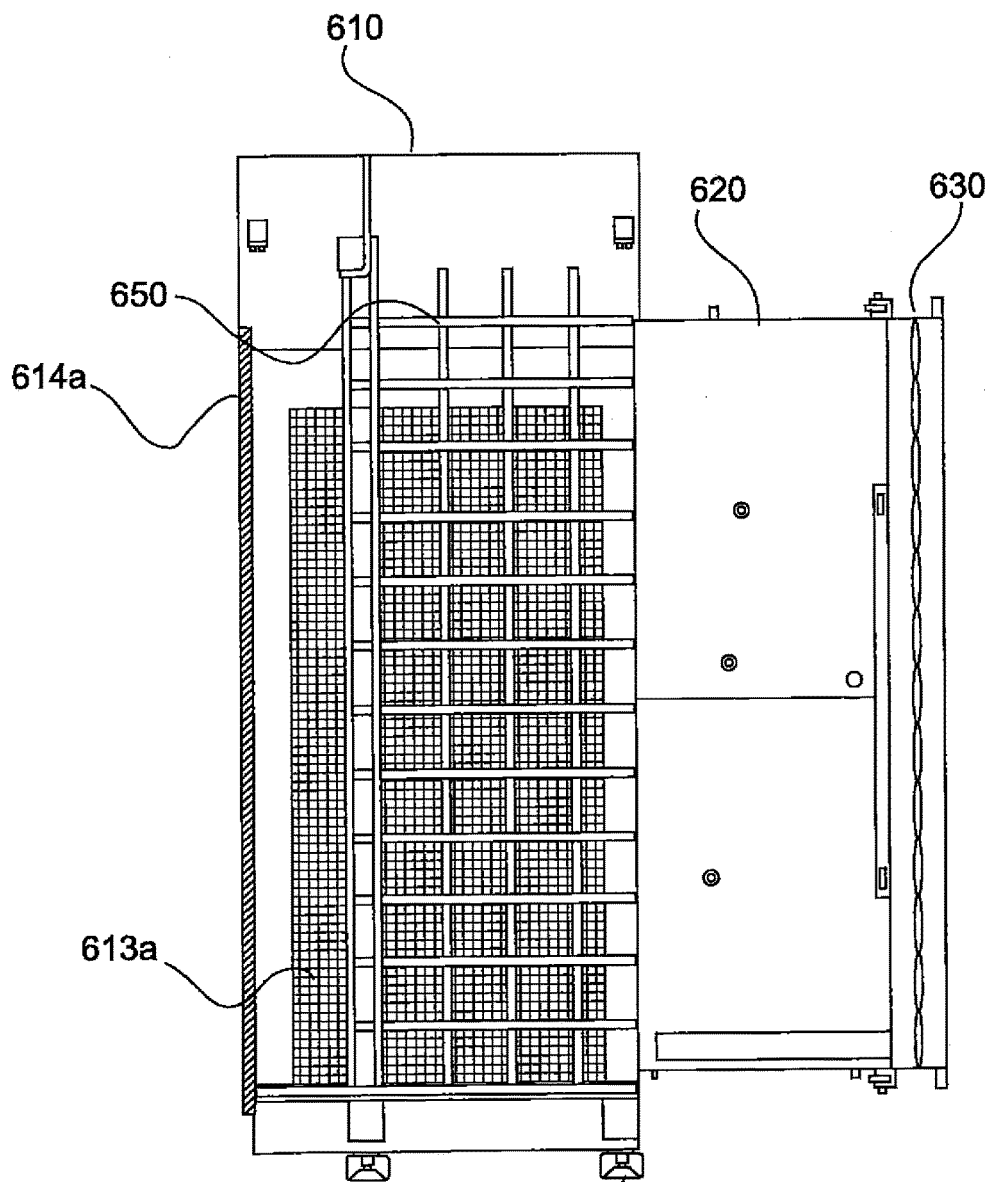


Fig. 4L 612

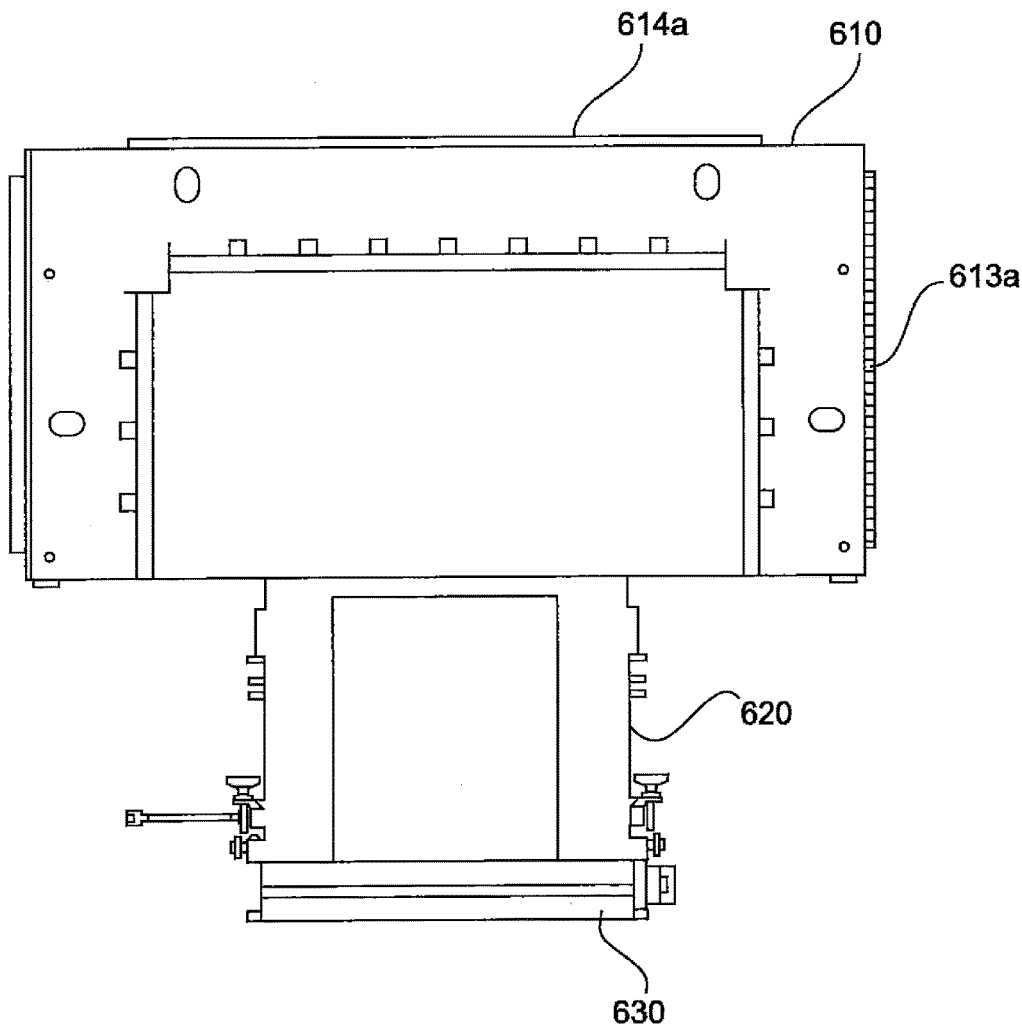


Fig.4M

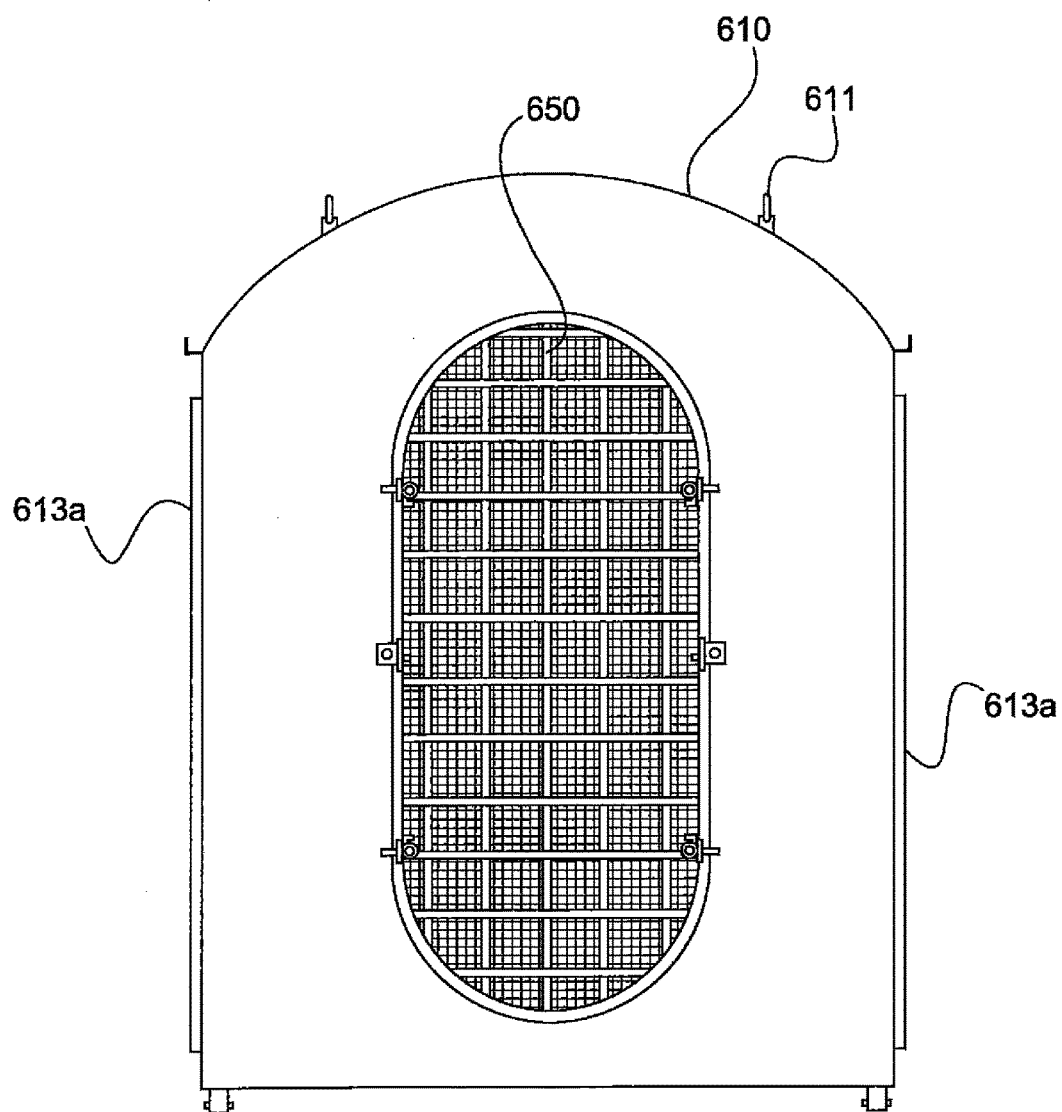


Fig.4N

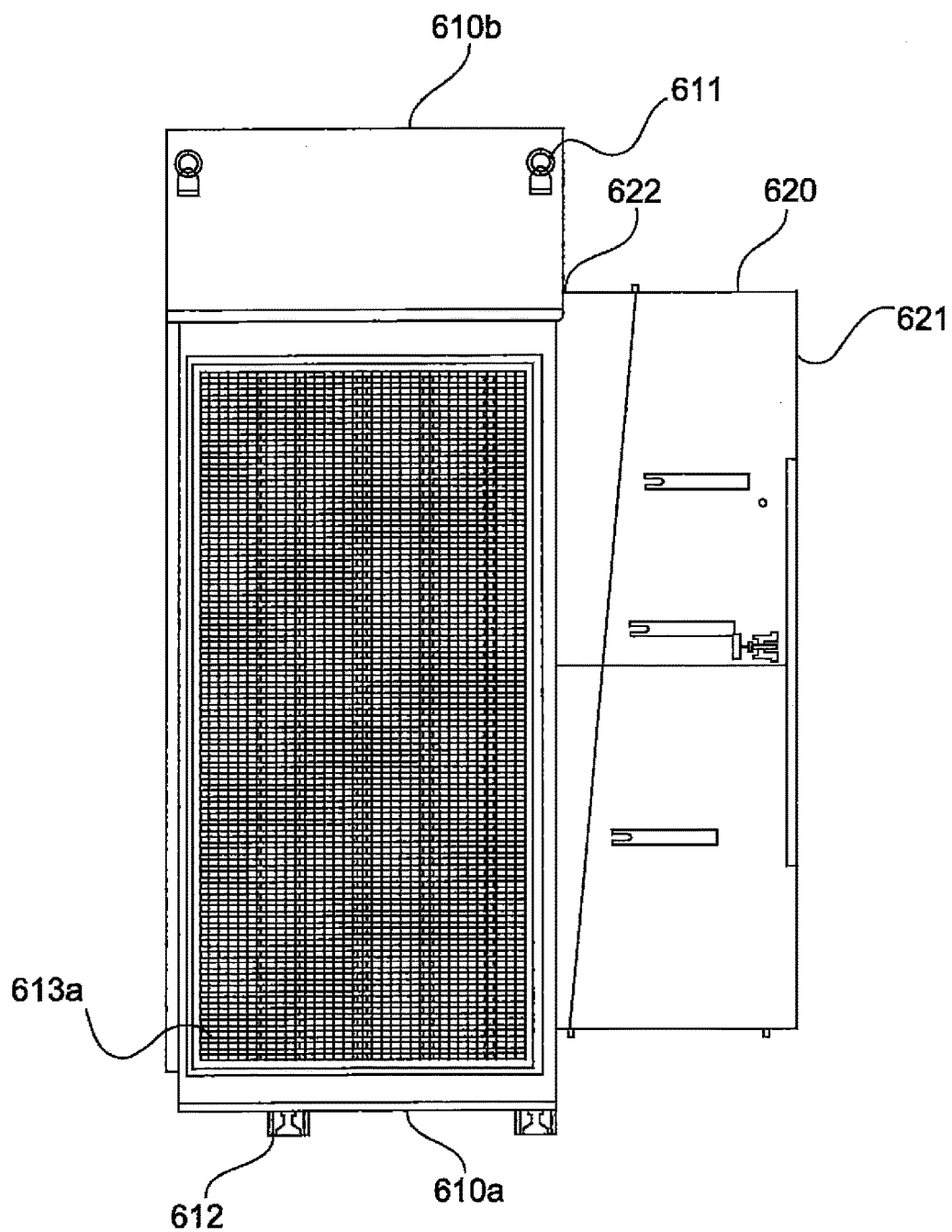


Fig.40

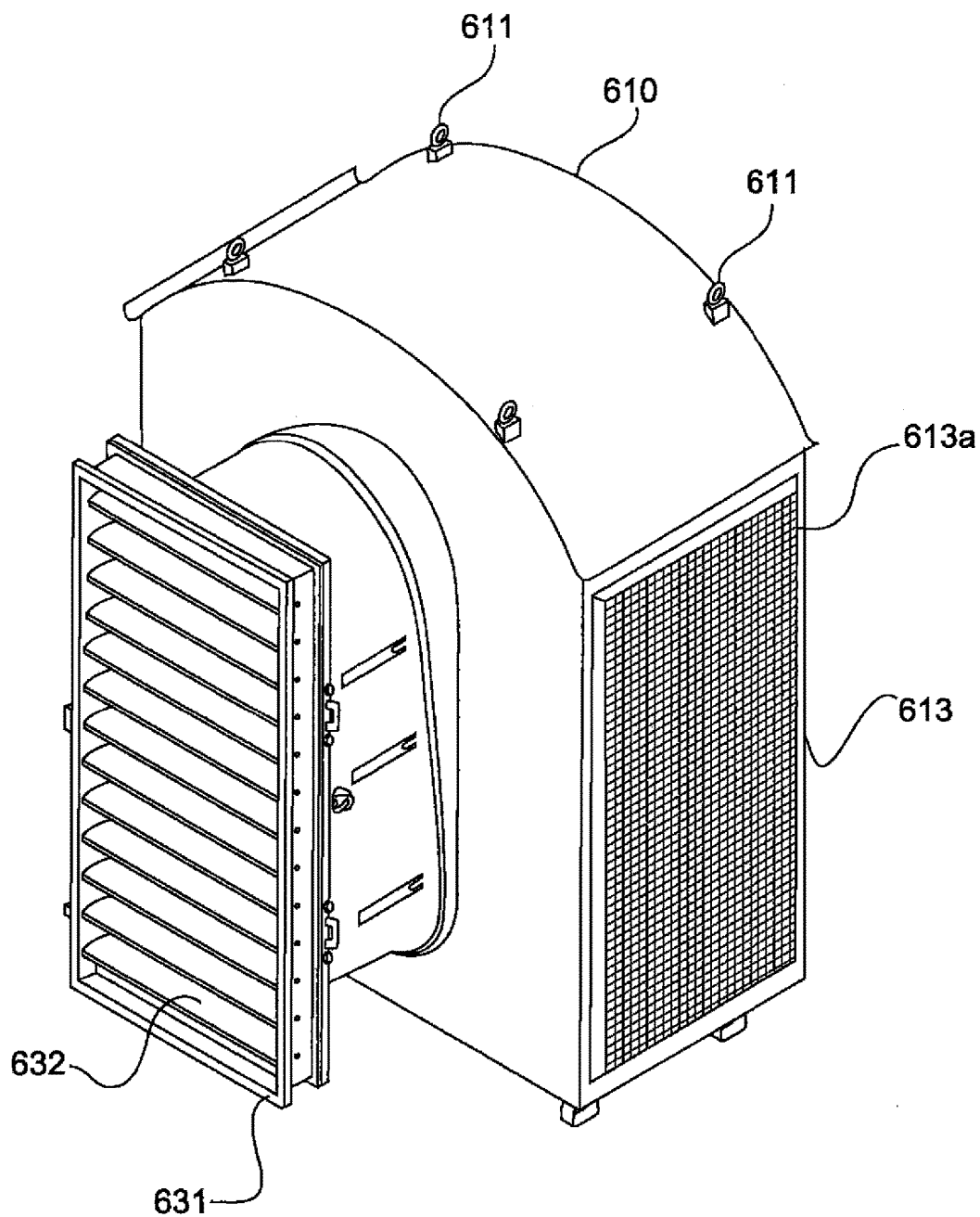


Fig.4P

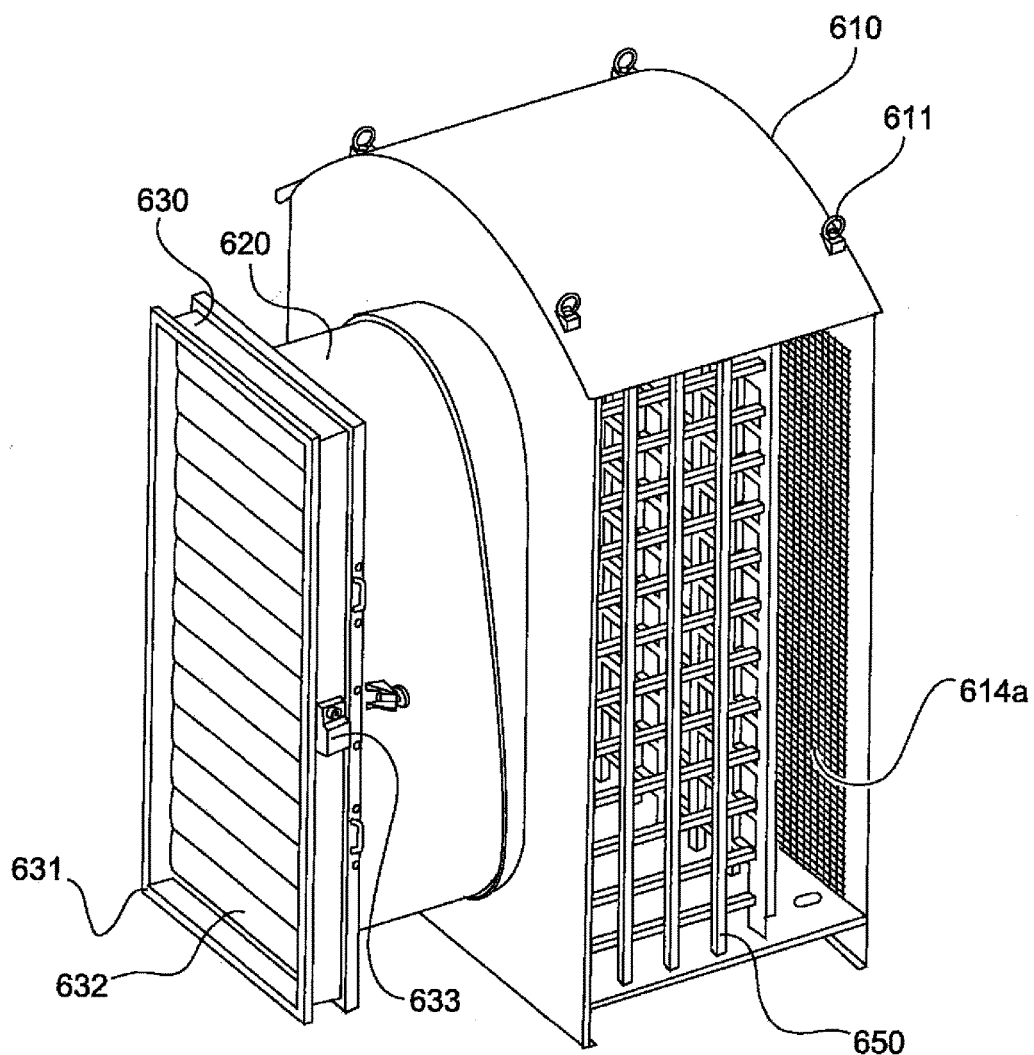


Fig.4Q

WIND TURBINE AND COOLING DEVICE FOR A WIND TURBINE

BACKGROUND

Technical Field

[0001] The present invention concerns a wind turbine and a cooling device for a wind turbine.

Description of the Related Art

[0002] Any wind turbine has a large number of components which in operation generate heat. Under given conditions like for example a high outside temperature, a prolonged period of operation at nominal power output, etc., those components have to be cooled.

[0003] On the German patent application from which priority is claimed the German Patent and Trade Mark Office searched the following documents: DE 10 2008 035 350 A1, AT 513 671 B1, US 2010/0308596 A1 and US 2013/0009405 A1.

BRIEF SUMMARY

[0004] Provided is a wind turbine and a cooling device for a wind turbine, which permits effective cooling of the wind turbine.

[0005] Thus there is provided a wind turbine comprising a tower which has a wall, a cooling device having an air inlet unit and an air outlet unit which are provided in the lower region of the tower. The air inlet unit and the air outlet unit each have an outer portion, a central portion and a shutter unit. The outer portions are provided outside the wall of the tower, the central portions are provided in the region of the wall of the tower and the shutter units are provided within the tower. The air inlet unit and the air outlet unit have fixing units, by means of which the central portions can be fixed to the wall of the tower from the interior of the tower.

[0006] According to an aspect of the present invention the outer portions have at least one protective grid, wherein bars of the protective grid are fixedly welded together.

[0007] According to a further aspect of the present invention the shutter units each have a shutter frame, shutter flaps and an adjusting unit, wherein the shutter flaps are displaceable by means of the adjusting unit.

[0008] According to a further aspect of the present invention the air inlet unit and/or the air outlet unit has a second protective grid in the interior of the outer portion. Also provided is a cooling device for a wind turbine, having an air inlet unit and an air outlet unit. The air inlet unit and the air outlet unit each have an outer portion, a central portion and a shutter unit. The outer portions can be arranged outside a wall of a tower, the central portion can be arranged in the region of the wall of a tower and the shutter units can be arranged within the tower.

[0009] The air inlet unit and the air outlet unit each have fixing units, by means of which the central portions can be fixed to the wall of the tower from the interior of the tower.

[0010] The invention concerns the notion of providing an air inlet and an air outlet for a cooling device in the lower region of a tower of a wind turbine. In particular the air inlet and the air outlet are to be of such a configuration that they are intrusion-resistant. In particular the air inlet and the air outlet are to be of a resistance class of 4, that is to say an

intruder should require longer than 10 minutes in order to be able to penetrate into the air inlet or the air outlet.

[0011] The air inlet can be in the form of an air feed cowl and the air outlet can be in the form of an air discharge cowl. The air inlet can have a drop separator and an air filter in a solid frame. Both the air inlet and the air outlet can have shutter flaps which are optionally controllable.

[0012] The cooling device can have heat exchangers, fans, passages for cooling fluid or ventilation passages.

[0013] Further configurations of the invention are subject-matter of the appendant claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0014] Advantages and embodiments by way of example of the invention are described in greater detail hereinafter with reference to the drawing.

[0015] FIG. 1 shows a diagrammatic view of a wind turbine according to the invention,

[0016] FIG. 2 shows a portion of a tower of a wind turbine,

[0017] FIGS. 3A to 3P respectively show various views of an air inlet unit according to a first embodiment, and

[0018] FIGS. 4A to 4Q show various views of an air outlet unit according to a second embodiment.

DETAILED DESCRIPTION

[0019] FIG. 1 shows a diagrammatic view of a wind turbine according to the invention. The wind turbine 100 has a tower 200 and a pod 104 on the tower 200. Provided on the pod 104 is an aerodynamic rotor 106 having three rotor blades 108 and a spinner 110. In operation of the wind turbine the aerodynamic rotor 106 is caused to rotate by the wind and thus also rotates a rotor or rotor member of a generator 102 which is coupled directly or indirectly to the aerodynamic rotor 106. The electric generator 102 is arranged in the pod 104 and generates electrical energy. The pitch angle of the rotor blades 108 can be varied by pitch motors at the rotor blade roots of the respective rotor blades 108.

[0020] For example the generator 102 or a power cabinet 101 (which for example have inverters, transformers and the like) can generate considerable heat during operation of the wind turbine, and that heat is to be dissipated by a cooling device 1000. The cooling device 1000 can have heat exchangers, fans, passages for cooling fluid or ventilation passages.

[0021] FIG. 2 shows a portion of a tower of a wind turbine. The tower 200 has a wall 201. For example a door 210, an air inlet unit 500 and an air outlet unit 600 as part of a cooling device 1000 are shown in the lower region of the tower 200. The cooling device 1000 has at least one air inlet unit 500 as an air inlet and an air outlet unit 600 as an air outlet. The tower can be placed for example on a foundation 300. A portion of the air inlet or outlet unit is provided outside the tower, a portion is provided in the wall of the tower and a portion is provided within the tower.

[0022] The air inlet unit 500 and the air outlet unit 600 can optionally be of the same design structure.

[0023] FIGS. 3A to 3H respectively show an outside view of an air inlet unit according to a first embodiment. The air inlet unit can be in the form of an air feed cowl and the air inlet unit 500 has a shutter unit 530, a central portion 520 and an outer portion 510. The outer portion 510 is disposed

in the installed condition outside the wall **201** of the tower **200** of the wind turbine. In the installed condition the central portion **520** is disposed within the wall **201** of the tower **200** of the wind turbine and the shutter unit **530** projects into the interior of the tower **200** of the wind turbine. The outer portion **510** has a bottom **510a** and an upper portion **510b**. Lifting eyes **511** for transport purposes can be provided in the upper portion **510b**. Transport protection units **512** can be provided at the bottom **510a**. The outer portion **510** has two side surfaces **513** and a front surface **514**. The side surfaces **513** and the front surface **514** respectively have a completely welded protective grid **513a** and **514a** as intrusion and vandalism protection.

[0024] Adjusting feet with a transport protection **512** can be provided at the bottom **510a**.

[0025] FIGS. 3I to 3M show various sectional views of the air inlet unit according to the second embodiment. A plurality of air filters **541**, **542** is provided within the outer portion **510** and behind the protective grids **513a**, **514a** respectively. The air filters **541**, **542** can be riveted both to each other and also to the outer portion **510**.

[0026] FIGS. 3N and 3O each show a view of the air feed unit, wherein the shutter unit is not installed.

[0027] FIG. 3P shows a diagrammatic view of an air feed unit with the shutter unit **530**, with the shutter flaps **532** being open.

[0028] The air inlet unit **500** can be introduced from the outside into an opening in a wall of the tower **200** (for example when the shutter unit **530** is removed). The central portion **520** can have a plurality of fixing units **525**, by means of which the central portion **520** can be fixed or screwed firmly to the tower wall from the interior of the tower wall. That fixing is so designed that it cannot be released from the exterior. Thus the air feed unit **500** cannot be dismantled from outside the tower wall.

[0029] The protective grids **513a**, **514a** can have solid bars which are welded and involve for example a mesh width of <100×100 mm.

[0030] FIGS. 4A to 4H each show an outside view of an air outlet unit according to a second embodiment. The air outlet unit **600** can be in the form of an air feed cowl and the air outlet unit **600** has a shutter unit **630**, a central portion **620** and an outer portion **610**. In the installed condition the outer portion **610** is disposed outside the wall of the tower of the wind turbine. In the installed condition the central portion **620** is disposed within the wall of the tower **200** of the wind turbine and the shutter unit **630** projects into the interior of the tower of the wind turbine. The outer portion **610** has a bottom **610a** and an upper portion **610b**. Lifting eyes **611** for transport purposes can be provided in the upper portion **610b**. Transport protection units **612** can be provided at the bottom **610a**. The outer portion **610** has two side surfaces **613** and a front surface **614**. The side surfaces **613** and the front surface **614** each have a completely welded protective grid **613a** and **614a** as intrusion and vandalism protection.

[0031] Adjusting feet **612** with a transport protection can be provided at the bottom **610a**.

[0032] FIGS. 4I to 4M show various sectional views of the air outlet unit according to the second embodiment. Provided within the outer portion **610** or behind the protective grids **613**, **614** is a protective grid **650** which comprises a plurality of welded steel or metal bars and is provided between the protective grids **613a**, **614a** and the central

portion **620**. The air filters **641**, **642** can be riveted both to each other and also to the outer portion **610**.

[0033] FIGS. 4N and 4O each show a view of the air discharge unit, with the shutter unit not being fitted in place.

[0034] FIG. 4P shows a diagrammatic view of an air discharge unit with the shutter unit **630**, the shutter flaps **632** being open.

[0035] FIG. 4Q shows a diagrammatic view of a ventilation unit **600** according to the second embodiment. Provided in the interior of the outer portion **610** is a grid comprising welded steel or iron bars **450**. That grid **450** is intended to serve as further intrusion and vandalism protection. Even if intruders have removed the outer grids **614a**, **613a**, they thereafter still have to overcome the further grid **650** to get into the installation.

[0036] According to an aspect of the present invention the cooling device **1000**, besides the air inlet unit **500** and/or the air outlet unit **600**, has further components which are required to cool the generator **102** and/or the power cabinet **101**. The cooling device **1000** can thus have heat exchangers, fans, passages for a cooling fluid or ventilation passages. The heat exchangers of the cooling device can be coupled by way of cooling fluid passages or ventilation passages or the like to the air inlet unit **500** and/or the air outlet unit **600**. The air inlet unit **500** and/or the air outlet unit **600** can optionally have heat exchangers or heat transfer means in order to discharge outwardly the heat of the cooling fluid or the heat from the air.

[0037] The present invention concerns in particular the air inlet unit and/or the air outlet unit of the cooling device for a wind turbine. The further configuration of the cooling device in the interior of the wind turbine can be of any desired design configuration.

1. A wind turbine comprising:

- a tower having a wall and a lower region, and
- a cooling device having at least one air inlet unit and at least one air outlet unit provided in the lower region of the tower,

wherein the at least one air inlet unit and the at least one air outlet unit each have an outer portion, a central portion and a shutter unit,

wherein the outer portions are provided outside the wall of the tower, the central portions are provided in the region of the wall of the tower and the shutter units are provided within the tower, and

wherein the at least one air inlet unit and the at least one air outlet unit have fixing units, wherein the central portions are fixed to the wall of the tower from the interior of the tower by the fixing units.

2. The wind turbine according to claim 1 wherein the outer portions have at least one protective grid with bars, and the bars of the at least one protective grids of the respective outer portions are fixed together.

3. The wind turbine according to claim 1 wherein the shutter units each have a shutter frame, shutter flaps and an adjusting unit, wherein the shutter flaps are displaceable by the adjusting unit.

4. The wind turbine according to claim 1 wherein at least one of the at least one air inlet unit or the at least one air outlet unit has a second protective grid in the interior of the outer portion.

5. A cooling device for a wind turbine comprising:
an air inlet unit and air outlet unit,
wherein the air inlet unit and the air outlet unit each have
an outer portion, a central portion and shutter unit,
wherein the outer portions are configured to be arranged
outside a wall of a tower, the central portions are
configured to be arranged in the region of the wall of
the tower, and the shutter units are configured to be
arranged within the tower, and
wherein the air inlet unit and the air outlet unit have fixing
units, wherein the central portions are configured to be
fixed to the wall of the tower from the interior of the
tower by the fixing units.
6. A wind turbine tower comprising a cooling device
according to claim 5.

* * * * *